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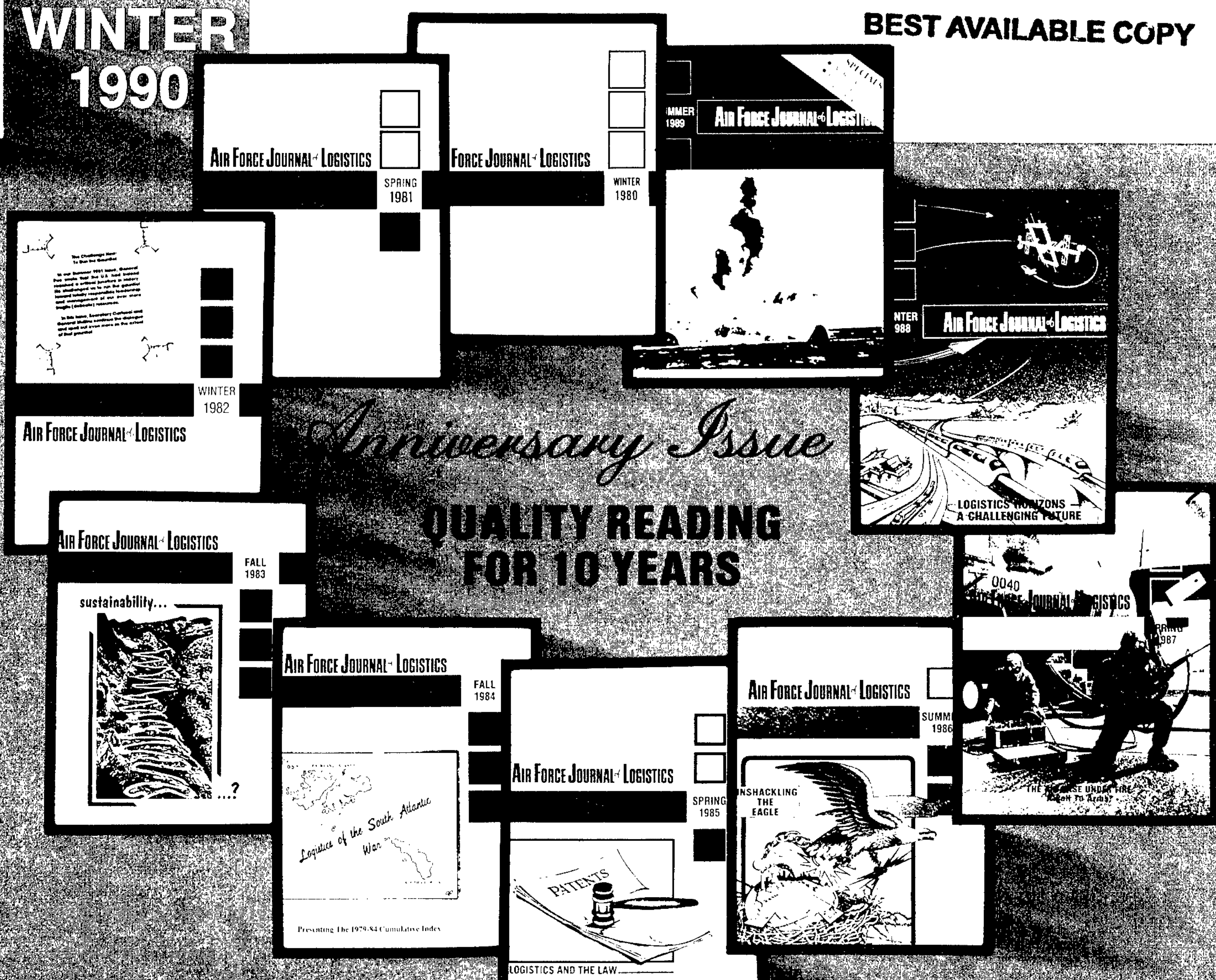
WINTER 1990



Anniversary Issue

QUALITY READING FOR 10 YEARS

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Purpose The *Air Force Journal of Logistics* provides an open forum for the presentation of issues, ideas, research, and information of concern to logisticians who plan, acquire, maintain, supply, transport, and provide supporting engineering and services for military aerospace forces. It is a non-directive, quarterly periodical published under AFR 5-1. Views expressed in the articles are those of the author and do not necessarily represent the established policy of the Department of Defense, the Department of the Air Force, the Air Force Logistics Management Center, or the organization where the author works.

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Manuscripts Manuscripts are welcome from any source desiring to deepen or broaden the knowledge and understanding of Air Force logistics professionals. They should be typed (double-spaced) and be between 1500-3500 words. Figures, graphics, and tables (separate pages) should be numbered consecutively within text. A Z-248 is available if author desires to send a diskette (ASCII file) along with the hard copy of the article (Address: AFLMC/JL, Gunter AFB AL 36114-6693; AUTOVON 446-4087, Commercial (205) 279-4087).

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INTRODUCTION

Over the last two or three years, US industry has recognized that quality is one of the most important ingredients in its drive to regain a competitive position in world and domestic markets. Today, DOD and particularly the USAF are sharing this awakening to the significance of quality and the role improved quality must play if we are to successfully meet the challenges presented by an environment of severely constrained resources and shifting priorities.

We celebrate the tenth anniversary of the *Air Force Journal of Logistics* with an issue dedicated to quality. While improving quality has been a recurring theme of the Journal during the last ten years, we anticipate this subject will become even more vital in the decade of the 90s and beyond. Our lead article which sets the stage for this "Quality" issue is taken from a speech presented by Mr D. Travis Engen, Senior Vice President of ITT Corporation, at the 24th Annual Society of Logistics Engineers Symposium.

Mrs Jane Allen, the assistant editor, and I appreciate the support we receive from readers of the Journal and hope this anniversary issue will be the first of many in the new decade to provide valuable information to Air Force logisticians.

Total Quality Management

D. Travis Engen
Senior Vice President - ITT Corporation

US National Security

I would like to talk about a vision. A vision of what might be. A vision that we must achieve. But before I get to the vision I want to give you some facts.

Our national security is recognized to be the result of two different aspects of our nation. One is our economic strength. The other is our military strength. Let us examine the economic situation first.

We in the US find our economic vitality threatened by the strong progress of other economies in the world. In the 50s, following the devastation of World War II, the US Gross National Product (GNP) was half of the world GNP. By the mid-60s, it was about 25% and it has held at about that level since then. Part of the decline is understandable. As other regions of the world have developed or rebuilt, their economies have become more significant elements of the total world GNP. But this does not account for all of the change.

Of more importance than the relative size of our economy is what has happened to the rate of productivity improvement since World War II. For the 17-year period up to 1965, US manufacturing productivity increased at the average rate of 3% per year. In the period from 1973 to 1979, it increased about 1.5% per year. From 1979 to 1986, it grew at 3% again. This is a strong recovery to the levels of the past, but it is not good enough to best the Japanese who have experienced nearly 5% annual improvements in productivity in the first half of the 80s.

In recent years our nation's economy has shifted away from a primarily manufacturing base toward a combination manufacturing and service or information base. The service business has clearly developed to be a larger part of overall activity, and the economy should shift to a new balance between manufacturing and service.

The strengths the US brought to manufacturing in earlier times have been applied to the information business. Our entrepreneurial spirit, our ability to rapidly exploit technology, and our speed of action have all been combined with the large free economy of the US to produce very large information or service businesses in a short period of time.

Unfortunately, as this developed, the productivity figures I outlined earlier show we did not keep pace in the manufacturing sector. Over the past decades, we have retreated from world leadership positions in industry after industry. This is true in steel, consumer electronics, and automobiles.

Turning now to the military basis for our National Security, we find that it also has undergone change in the last few decades.

The military national security strategy is based on three elements. The first of these is the strength of our alliances. While NATO has been the most significant of these for 40 years, we have many other alliances throughout the world.

The second element is the makeup of the American people. The personal characteristics that we identify as typical of the American Spirit—initiative, independence, a sense of obligation to do right, and the willingness to sacrifice for others—distinguish our forces and are a basic tenet of our military doctrine.

The third element is the technological superiority of our weapons and military equipment. Technological superiority has been our credo for many years, as we judged that we would not manage our military budget to outspend the Soviet Union. In simpler terms, we sought to emphasize Quality, not Quantity.

Just as there have been changes in the mix of our economy, there have been changes in our ability to field technologically superior tools for the military. In a recent book, *Affording Defense*, Jacques Gansler presented data on the time required for the full-scale development of a wide range of military systems. The data covered development programs that began in the 50s up to those beginning in the 70s. In all categories of equipment, development time increased. Today, the average full-scale development takes about 7 years. Bombers, command and control systems, and air-to-ground weapons take longer, ranging from 8 to 11 years. The shortest category is surface radars at 6 years.

This means that the basic technology in our newest systems is at least 6 years old and may be more than a decade old when the systems *start* production.

Over the same period of time, technological advances have accelerated. Since the transistor entered the market over 30 years ago, technology has moved to integrated circuits of rapidly increasing functional capability. Memory circuits have gone from core to RAM: from the 16k RAM to the 64k RAM to the 256k RAM and now the 1 megabyte RAM. The same story has repeated itself in all classes of electronic devices.

Breakthroughs in the nonelectronic areas have also accelerated.

When you combine the accelerating pace of technological development with the lengthening full-scale development time, the result is that each new system entering military service is increasingly obsolete. We have gone from fielding systems with technology 1 to 2 generations behind the laboratory to systems with technology 3 to 5 generations behind in just 20 years.

This does not ensure the technological superiority of our forces, and we must conclude that one-third of our national strategy is not what it used to be.

When you examine our national security as I have, a common pattern emerges. Whether we talk about the economic basis for our security or the military basis for our security, it comes down to the strength of the manufacturing sector of our economy. And it becomes clear that we have experienced a significant reduction in national and industrial competitiveness in the world.

Vision of Industrial Competitiveness

Let me now build a vision for you. Imagine for a moment that products and services are continuing to improve in quality. And I mean quality as defined by the total satisfaction of the user of the product. Imagine that this is so true that you begin to have "unreasonable" confidence in products and services you have not tested yourself or that do not even exist yet. You "know" they will exceed your expectations.

Imagine that the prices for these products and services are declining as the satisfaction with them is increasing.

Imagine that new products and services are being introduced with ever shorter development times—that the time from concept to implementation is half what it used to be and shrinking.

Imagine that new technology is being introduced constantly—that new, unthought-of features are being introduced with each new model or service level.

With the situation I described earlier, this vision may seem farfetched. Does it seem to you that our system has gotten so complex that we could never attain this vision?

Well, this vision is being achieved today. In Japanese cars. In consumer electronics. In office automation and personal computers. And in other areas.

Since the late 70s, the industry leaders in these markets have cut in half the time they required for product development. Even with the accelerating pace of technological change, new products have technology only a generation removed from the laboratory.

Many of these achievements are being made in Japan. Usually examples of Japanese superiority are accompanied with statements about the special conditions they use to advantage. Lower labor rates, debt financing, differing accounting standards, tax policies, and dumping are frequently cited.

I believe the reasons are broad and many. I also do not believe the ones I have just cited are the major ones.

Sometimes you hear they have "silver bullet" technical tools, or better computer integration and linking, or brighter people, and so on. These are not the major reasons either.

More and more observers are coming to the realization that the *reason is management*. It is the management style, the commitment to winning, and the commitment to continually improving—even in the absence of competition—that can make the difference.

Characteristics of Competitive Enterprises

This situation has not gone entirely unnoticed. People have been calling attention to these problems for at least a decade. In recent years an increasing number of books have been published on the subject of US industrial competitiveness. Some good examples are *World Class Manufacturing* by Schonberger, *Dynamic Manufacturing* by Hayes, Wheelwright and Clark, and *Made in America* by the MIT Commission on Industrial Productivity. There have been debates in the media and in Congress. And a number of companies have decided for themselves to respond.

Usually these companies have been responding to a "life-threatening, emotional" event. Highly visible examples are Chrysler (basically bankrupt), Ford (threatened by the Japanese car producers in the late 70s), Xerox (significant loss of market share to Japanese competitors), John Deere, and Harley-Davidson.

Typically, the threat these companies faced caused them to examine themselves and their competitors very closely. And what they learned fit into some broad categories.

First, they learned that successful companies were very committed to their customers and markets. Satisfying the customer, meeting the market came first. The winners knew that, without customers, nothing else could succeed.

Second, the successful companies had a drive to get increasingly better at what they did. They had formal methods of measuring themselves and others to determine the "best in class." These measures became the basis for examination and improvement.

Third, there was recognition that the process used to create a product intrinsically determined many of the product's quality characteristics. Process and process improvement were essential to quality.

Finally, there was a recognition of the value of long-term partnerships. Just as they were striving to achieve long-term partnerships with their customers, they began to see that long-term partnerships with suppliers with the same commitment to their customers and markets, the same commitment to continuously improve, and the same recognition of the importance of process would serve them best.

As these companies took actions on their findings, the results paid off. Chrysler and Ford have clearly rebounded. Xerox has regained market share. John Deere and Harley-Davidson are strong companies once again. The managers of these companies know they have not won the race, but they are back in it. By the very nature of the concept of continual improvement, they know they must continue to examine themselves and find ways to be even better to stay in the race.

Total Quality Management

Various names have been given to the programs these companies undertook. Perhaps most broadly recognized is Total Quality Management, or TQM.

TQM embraces a range of concepts, but the essence is working cooperatively between producers and customers (at all levels, internal and external) to understand the needs and bring the best match of available abilities to serve them. It means examining the level of capabilities against the best in the world and finding means to improve them and, in the event of achieving world leadership, continuing to improve even further.

The consequences of TQM for most of our organizations are not painless. In general we are finding that the way our organizations have evolved does not support close examination of capabilities and change for improvement. We find that we have created functional organizations or baronies—organizations that have too many levels and are not responsive enough. But painful as the change may be, the resulting vigor and drive of the new entity are exciting.

When you have begun the self-examination of TQM, you learn of other new (and some not so new) tools and techniques: statistical process control, Taguchi methods, cause and effect diagrams and cards (CEDAC), Continuous Flow Manufacturing, Concurrent Engineering, Fishbone charts, Pareto analyses, and many, many more. I would like to discuss Concurrent Engineering a little further. Concurrent Engineering is important because it addresses the process of bringing products from identification of need to selection of concepts to creation of the product. It can also address the defense product development/accelerating technology dilemma I described earlier.

Concurrent Engineering can be defined as the systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. The approach is intended to cause the developers to consider from the outset all the elements of the product life cycle from conception through disposal including quality, cost, schedule, and user requirements. (This rather formal definition is paraphrased from a good Institute for Defense Analysis report on the subject.)

Successful practitioners of Concurrent Engineering are completing development of new products in half the time, requiring less money and producing measurably greater user satisfaction with the resulting products.

Do any of you remember any other such significant impact on development programs? My view supports the Gansler data I described earlier; developments *are* taking longer. But they do not have to.

TQM: the most important initials for America that I know. It is only through widespread understanding that serving the need of the customer with quality products and services, recognizing the value of examining our competitiveness, and striving to continually improve both that we will regain what we have had in our society and our place in the world. Only then can we attain the level of national security we must have if we intend to lead the world in the decades ahead.

We must get involved and participate in the revitalization of our country.

Total Quality Management: A Leadership Revolution

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Total Quality Management is defined in the 4 May 1989 OASD (P&L) TQM-IPQ Fact Sheet:

> Total Quality Management (TQM) is both a philosophy and a set of guiding principles that represent the foundation of a continuously improving organization. TQM is the application of quantitative methods and human resources to improve the material and services supplied to an organization, all the processes within an organization, and the degree to which the needs of the customers are met, now and in the future.[1]

Compare this to what A. V. Feigenbaum defined as Total Quality Control in 1951:

> An effective system for integrating the quality-development, quality-maintenance, and quality-improvement efforts of various groups in an organization so as to enable marketing, engineering, production, and service at the most economical levels which allow for full customer satisfaction.[2]

The difference is in the establishment of a "foundation for continuous improvement." This antithesis of the famous American saying, "If it ain't broke don't fix it," is what makes TQM the next revolution in American business and in DOD. TQM expands on the work of Dr. W. Edwards Deming, Dr. J. M. Juran,[3] and Feigenbaum, and it is applicable to both the government and nongovernment organizations.

In TQM, quality is defined as **providing the customer what he expects to receive.**[4] One must therefore be able to define the customer and understand his desires, expectations, and preconceived notions. No customer expectation is too strenuous, too extreme, or too outrageous. Within this framework, anything is possible.

Quality expectations are achieved through a focus on five elements:

(1) People
(2) Equipment
(3) Materials
(4) Methods
(5) Environment[5]

Each element is focused on the business operation and organized to meet customer expectations through a process of continuous improvement. These products, whether internal or external (Figure 1) will have robust designs, and, when measured against standards, will be grouped close to the mean[6] with very little variability.

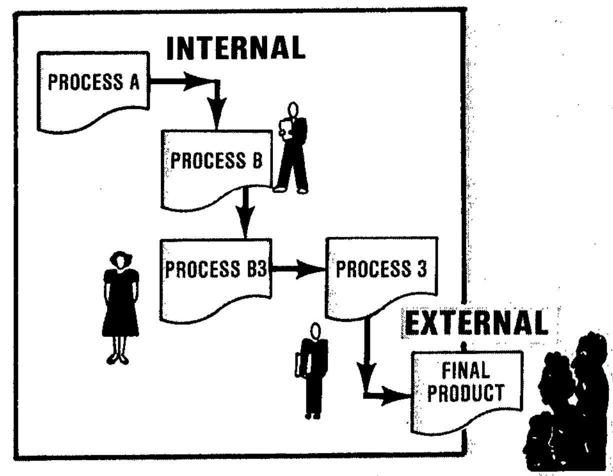

Figure 1: Internal and external customers.

Principles and Key Concepts

TQM is an all-encompassing concept that combines technical aspects of quality, qualitative methods, and human resources in a system designed to provide the customer with the very best product. Processes and techniques are integrated within a system that is focused on continuous improvement through highly trained and motivated system members.[7]

Principles

TQM principles serve as the foundation for managers and other system members to use in analyzing decisions and future planning actions. They provide a framework to assess outcomes and appraise behavior. TQM's nine principles guide the work done by each member of the system, and they force accountability of the system on management:

(1) Continuous Process Improvement
(2) Process Knowledge
(3) User Focus
(4) Commitment
(5) Top-Down Implementation
(6) Constancy of Purpose
(7) Total Involvement
(8) Teamwork
(9) Investment in People

Key Concepts

Management Involvement

An important fundamental of TQM is that managers at the uppermost levels of the organization must initiate a quality revolution in their organization. TQM will succeed only with the constant commitment of senior leaders. If top management is totally committed to a cultural change and, if that is transmitted throughout the organization, achievement can be realized. Without top management involvement in TQM, the cultural change will be like most other programs—it will come to an end. This idea was expressed by James Harrington when he said, "The improvement process starts with top management, progresses at a rate proportional to their demonstrated commitment, and will stop soon after they lose interest in the process."[8]

Continuous Improvement

The hallmark of the TQM process is continuous improvement.[9] The continuous improvement concept relies on developing systems and processes that *build* quality into a product, not *inspect* it in. Continuous improvement requires that improvements occur *beyond* an "acceptable" quality level; it puts quality first, before cost and schedule; and continuous improvement never ends.[10] TQM focuses on seven areas of continuous improvement:

(1) Management must be of such quality that, throughout the organization, managers find ways to inspire, motivate, and educate employees in the continuous improvement process.

(2) The quality of all processes, at all levels, must be assured at all times.

(3) TQM focuses the efforts of the entire operation on customer satisfaction.

(4) TQM relies heavily on functional teams. The TQM organization is made up of process teams that are a part of larger functional teams which are a part of end-product teams.

(5) TQM requires the total commitment of top management.

(6) TQM relies on statistical process control to determine where any problems are, to evaluate cause-and-effect relationships, and to assist in a systematic decision-making process designed to solve these problems.

(7) TQM requires more training than other systems because TQM is an unending process.

A continuous improvement system cannot be established overnight. It takes a long time to implement it fully, and it should be developed in a time-phased approach designed to keep the attention and interest of both managers and employees.

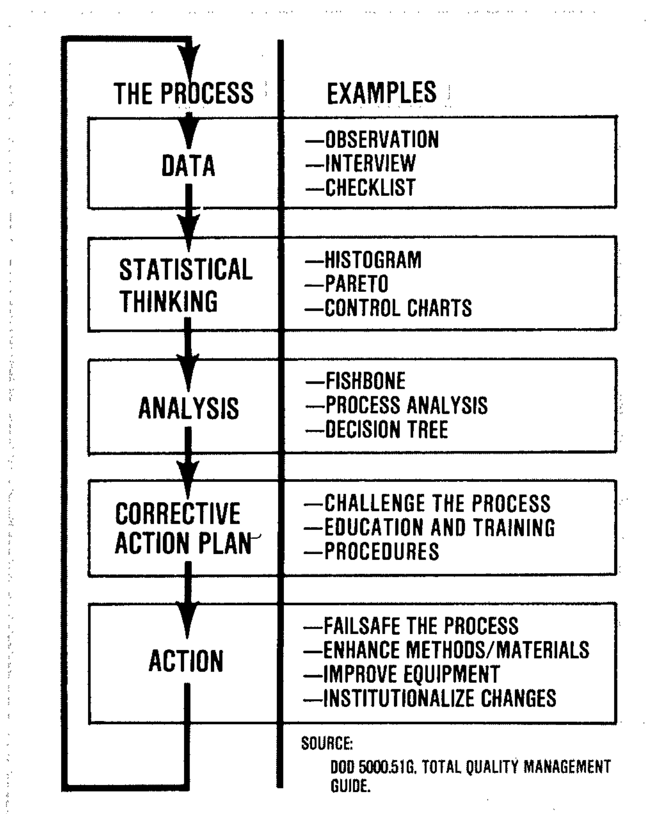

Figure 2: Improvement cycle.

Management of Outcomes Versus Management of Processes

The typical management approach reacts to events that occur in the system; the TQM approach continuously works on the system. The first approach corrects problems topically, without understanding the systemic causes. In many cases the topical correction causes problems in others. The latter approach understands the system and how it functions. It determines cause of problems and then corrects it. TQM formalizes the process and makes it routine. The formalization occurs in seven major areas:

(1) **Planning and Goal Setting**. Planning through goal-setting attempts to forecast the future. It sets the organizational course. Effective planning forces the system to review customer requirements concerning people, equipment, methods, materials, and the environment (Figure 2).

(2) **Promoting Improvement.** The best way to promote an improvement program is to live and breathe it every day. Quality and improvement should be the first things system workers think of before they take any action and the last things they think about when they evaluate the corrective action. Current reward programs should be rewritten to reflect improvement efforts as the single most important criteria.

(3) **Process Improvement.** Process improvement is the practice of breaking down all the organization's processes into well-defined activities and then improving each activity.

(4) **Signals.** The right signals go a long way toward keeping the attention of system workers. Any slackening of senior management commitment will cause shock waves throughout the organization and TQM will die a sure death.

(5) **Communication.** Constructive and uninhibited communication up and down the organization is critical to the success of TQM. One of the first processes reviewed is that of communication within the organization.

(6) **Skill-Building.** TQM is not free, but investment in it will return great rewards. The predominant cost of TQM is in training and skills building.

(7) **Resource Optimization.** Part of the payback in TQM is that processes and resources are less costly to operate and maintain than in a traditional organization. TQM frees individuals to look at each process and determine the optimum amount of resources at just the right time.[11]

Deming, Juran, Feigenbaum, and Philip Crosby appreciated the need to go beyond the quality inspection charts and incorporate the essentials of human dynamics, organizational development, and motivational theory in TQM. The key concept is that management must take responsibility for the system. As Deming said, "It is management's responsibility to work *on* the system, while the worker labors *in* the system."

The Fourteen Obligations of Top Management

The goal of TQM is quality. One aspect of ensuring quality is the elimination of obstacles that hinder quality improvement, many of which were established by management. To underscore the importance of the management change needed, Dr Deming developed "The Fourteen Obligations of Top Management."[12] They are the basic elements taught to the Japanese in the early 50s. The fourteen obligations of top management are:[13]

(1) **Create constancy of purpose toward improvement of product and service, with the aim of becoming competitive and staying in business and providing jobs.** Management must do everything possible to eliminate the quarterly profit and loss mentality, which is one of the biggest detriments to long-term growth in our country.[14] Managers and leaders must establish a structure that will be around for the long run. The practice of moving managers and leaders frequently must be stopped; frequent movement causes them to come into jobs with a short-term

attitude and to leave with the same attitude. Promotions should be based on all their past positions in the organization, not just the last one. The continuous improvement process should also include better methods of production, better application of materials, revitalized training, retraining, continuous updating of training aids, and training funds for the future. Part of today's funds must go toward research and development to improve products, maintenance, and service; without an understanding of the customer's future requirements, an organization will not be prepared to meet the challenges.

(2) **Adopt a new philosophy. We are in a new economic age. Western managers must awaken to the challenge, learn their responsibilities, and take on the leadership for change.** According to Nancy R. Mann, "This goal will only be achieved if we demand high quality, dependable products, and/or services."[15] Too often shortsighted managers allow lower quality and undependable products. Some managers actually plan for low quality, less dependable products, defects, workers who don't know their job, poor training, worse supervision, slipped schedules, and cost overruns. *If you plan for poor quality, you will get poor quality.*

(3) **Cease dependence on inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place.** *Build* quality in—don't *inspect* it in. The best way to build quality into the product is through robust design and the elimination of variability. To understand variability, one must use statistical process control techniques. Statistical design has not been used much in the United States; but where it is used extensively, that industry dominates the world market.[16] Statistical process control uses such tools as flow charts, Pareto diagrams, cause and effect diagrams, run charts, scattergrams, and histograms. Workers who know how to apply statistical process control techniques are better able to find the problems an inspector would find. When the system worker finds problems and corrects them, it is looked at as part of the job; when an inspector finds errors, it is considered a failure. And blame is generally assigned to the system worker, not management. As quality improves, inspection should decrease. Lack of inspections can even be used as a reward for units that are producing quality products and/or services. In addition to eliminating the reliance on mass inspection, replacing military quality standards with a statistical process control system geared to continuous improvement would go a long way to recognize producers who know quality and not just the quality standards.

(4) **End the practice of awarding business on the basis of the price tag. Instead, minimize total cost. Move toward a single supplier for any one item, building a long-term relationship of loyalty and trust.** Dr Deming's feelings on this subject are presented in the following quote. He is referring to the purchase of municipal buses from the lowest bidder.

> To have somebody that knows something about quality, they'd have to pay money. Such people are high priced. But they would save untold sums of money. It requires only a third-grade drop-out to observe which price is the lowest, and he's the one that gets the job.
>
> There's a better way today. We're in a new economic age, which requires that suppliers give statistical evidence of quality in the form of control charts and evidence that they are working on all 14 points. Quality and competition are not directly related when the goal is the low-bidder. All bidders for a product or service should be required to prove that they employ statistical process control and that the products they are offering are in statistical control. When this happens bidders will be forced to look for the best with the lowest cost of ownership, not the lowest initial price, with the highest ownership cost. Additionally, this will force bidders to develop long-term relationships with their suppliers who are in statistical control and able to provide quality parts, not low-priced parts. In the long term, high quality parts in statistical control will be low cost parts.[17]

(5) **Constantly improve production and service system to improve quality and productivity and thus constantly decrease cost.** Don't wait for things to go wrong. Put the entire work force in a posture to find problems before the system goes out of control. Plan for a system that is forever in control, forever getting better. Retrain quality inspectors to become teachers of statistical control and advanced experiment facilitators. Make them a part of each work unit.

(6) **Institute training on the job.** An employer cannot expect to hire fully trained employees. Company training is therefore mandatory. Training is a continuous process that matches the needs of the worker to the requirements of the system. Both benefit through increased satisfaction and productivity. Statistical methods should be used to determine what training is needed, when it is needed, and when it is complete. As training becomes effective, product quality improves. In those rare cases where the proper training has not improved the output of a unit or individual, that unit or individual should be relocated or discharged.

(7) **Institute leadership (see point 12a). The aim of leadership should be to help people and machines do a better job.** Too little attention is given to training supervisors and ensuring they are managing in statistical control. Management must teach supervisors what their jobs are and allow them to ask questions. The supervisor should serve as a coach, helping system workers solve problems. Foremen and mid-level supervisors are essential to quality education. And top leaders must recognize that continuous improvement is the means to achieve customer satisfaction. The leaders of organizations must find ways to reduce the amount of time foremen and supervisors spend doing nonproductive work. Some activities and situations that are commonly found in organizations and that might be classified as nonproductive are:

- Weekly sign-off of time cards verifying attendance
- Inspection of incoming parts between divisions
- Clerks in approval cycle of manager's travel request
- Work measurement system
- More quality standards
- An acceptable quality level
- Ineffective communications systems
- Travel instead of teleconferencing
- No preferred suppliers list
- Required second sourcing
- 400-page requests for proposal (RFPs) and 800-page proposals

(8) **Drive out fear, so that everyone may work effectively.** Dr. Deming estimates that probably 80% of American workers do not know and are afraid to ask what their jobs are.[18]

> And why is the American worker afraid? Well, somebody trained him, maybe the foreman. But he still doesn't understand what to do. Or there is some material that is unsuited to the purpose. He asks for help two or three times, but the foreman never has any time or tells him, 'Well, it's the way I told you.' So the worker doesn't wish to be a trouble maker. He works in fear.[19]

Top managers are not only responsible for other components of the system, but also for supervision. Supervision that instills fear and fosters ignorance is intolerable. Like other parts of the system, supervision must be continuously improved. Supervisors must be trained in statistical process control techniques so they can identify quality costs and help workers eliminate barriers to quality. Supervisors must not be afraid to ask questions, flag problem areas, and make suggestions.

(9) **Break down barriers between departments. People in research, design, sales, and production must work as a team.** The time has come to break down the walls that nurture divisions

within the system. These walls prevent cooperative work between and across functions. The lack of cross-functional assignments has contributed to worker ignorance of the total organization. This must change! Everyone must contribute to the system's goals. Multifunctional teams with common goals and objectives should be the goal of every senior executive officer, divisional manager, supervisor, foreman, and worker.

(10) **Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity.** If the company president wouldn't hang the poster in his office, it doesn't belong on the shop floor. Posters should reflect company goals, the status of the work being done, and the work that is not yet under statistical control but is getting there. Give the workers a map of where they have been, where they are, and where they are going. (A slogan like "Zero Defects" tells them what is expected but not how to get there.) "The slogan advertises to the work force that management is helpless to solve the problems of the company. Do they need to advertise? The workers already know it."[20]

(11a) **Replace work standards (quotas) on the factory floor with leadership.** Work standards have a way of limiting improvement because the workers know that their every movement is measured and gauged. The best form of work measurement in a production operation is statistical process control. Once a process is in control and the efficiencies found, no work measurement system will improve the process. Quotas emphasize quantity over quality, leading eventually to higher cost.

(11b) **Eliminate management by objective. Eliminate management by numbers. Substitute leadership.** Management by objectives is the misapplication of a good concept. Objectives are established by management and forced to lower levels where lower level objectives must be created to support the higher level ones. This imposes a requirement on system workers without giving them a means to satisfy it. Further, the documentation required—along with the cheating that occurs in reporting the progress—is counter-productive. Managing through the use of vision, goals, and objectives can be effective, however, if two conditions are met: objectives should originate at the lowest levels of the organization after a clear understanding of the organization's vision is in place, and the documentation should be the same as that used to measure and maintain process control.

(12a) **Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from numbers to quality.** Satisfied workers do not set out to produce bad products or provide poor service. If they do a poor job, it is because the system failed to ensure they stayed within the desired control. To ensure they know when a worker is about to fall out of control, managers must establish communication lines through which information can freely pass. These lines of communication are critical; through them come warnings of approaching dangers. Teamwork requires communication and inspires pride in daily work.

If every team of ten members was able to bring one individual's behavior closer to the group's mean, the entire system would be improved. In any group, someone has to be in the top percentage and someone has to be in the bottom percentage—we cannot change the laws of distribution. But we can reduce the variability between the top 10% and the bottom 10%, and we can increase the pride possessed by the lower 10%.

(12b) **Abolish the annual or merit rating.** TQM offers a replacement for annual ratings: statistical process control and teamwork. Bill Scherkenbach, Ford's director of statistical methods, said the performance system "destroys teamwork and cooperation, fosters mediocrity, increases variability, and focuses on the short term. In addition, it treats people like commodities and promotes fear and loss of self-worth."[21] But, an annual performance system can work if the areas of measurement are changed to teamwork, long-term goals, and continuous process improvement. Too often, annual appraisals are based on outcomes not under the control of the individual, but rather the system. Only about 15% of a company's processes are under the control of workers; the other 85% are under the control of management.[22] Appraisal systems will work if they are fairly applied and consistent with the goals and objectives of the organization, and if they provide information the worker can use for continuous self-improvement.

(13) **Institute a vigorous program of education and self-improvement.** TQM is effective when everyone in the organization is trained in basic statistical process methods. They must understand these methods and use them to solve problems. As the entire organization is trained in statistical process control, it frames the way the organization looks at problems and corrects quality deficiencies.

(14) **Put everyone in the company to work on the transformation.** It is not only important to put in a system for continuous improvement, but it is also important that everyone be involved in making that system better.

If there is one thing different between TQM and any other management program, it is that TQM is for everyone.

Conclusion

Total Quality Management is not new. The basic concepts presented have been with us since the 50s. They include such business practices as focusing our efforts on the customer, regardless if the customer is internal or external; training our people to do the job we expect of them; eliminating barriers that inhibit good performance; and continuously improving whatever tasks we perform.

Successful leaders recognize that the total quality culturalization of their organizations is not something that happens over night. As such, they establish long-term visions, prepare their companies and employees for a quality change through training and education, and ensure all the proper signals are in place to leave no doubt that theirs is a total quality managed team.

Author's Note: A short article like this one only touches on the concepts of TQM. For a fuller understanding, I suggest reading at least one of the following books:

Mary Walton, *The Deming Management Method* (New York: Perigee Books, 1988).

William W. Scherkenbach, *The Deming Route To Quality and Productivity: Road Maps and Roadblocks* (Rockville, MD.: Mercury Press, 1988).

Howard S. Gitlow and Shelly J. Gitlow, *The Deming Guide to Quality and Competitive Position* (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1987).

Notes

[1]OASD (P&L) TQM-IPQ Fact Sheet, Subject: Total Quality Management, 4 May 1989.

[2]Feigenbaum, A. V. *Total Quality Control* (New York: McGraw-Hill, 1983), p. 6.

[3]Department of Defense, "Total Quality Management Master Plan," August 1988, p. 1.

[4]Dr. Tribus, Myron. *Quality First; Selection papers on Quality and Productivity Improvement* (Cambridge, Mass: Massachusetts Institute of Technology, 1987) defines quality as"...giving people what they have the right to receive." I have chosen to orient the focus on quality to assert that customers must first clearly establish what their requirements are. After that has been done, quality is what they expect.

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Professional Logisticians—Does the Air Force Have Any?

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Introduction

In the Summer 1988 issue of the *Air Force Journal of Logistics*, Lloyd K. Mosemann, II, Deputy Assistant Secretary of the Air Force (Logistics), voiced concern about the development of the "professional logistician." In recent years, the senior leadership of the Air Force has been more vocal in expressing its concern and frustration with existing and proposed civilian logistics career programs. At the highest levels this concern has been voiced by Dr. James P. Wade, Jr., former Assistant Secretary of Defense for Acquisition and Logistics, and Mosemann; at the lower levels this concern surfaces as the individual career civilian logistician looks for some definitive direction for his/her career. This article describes research conducted by the Air Force Institute of Technology (AFIT) to define the "ideal," or "professional," civilian Air Force senior logistician and compare current GM-15 logisticians to that ideal.

As military weapon systems employ more high technology, the responsibilities of the Department of Defense logisticians have become more complex. As defense budgets continue to decline, the job of providing logistics support has also become more difficult. (8:3) Logisticians must, therefore, find new ways to do more with less as higher percentages of today's total weapon system life cycle costs are attributed to logistics. One solution is to truly implement an integrated approach to logistics management.

In 1986, Wade stated that a major problem with developing logisticians capable of implementing this integrated approach to logistics support was the "lack of an integrated approach to logistics career development." (8:4) He suggested logisticians need to become "professionals" who understand the full spectrum of logistics activities and interrelationships and expressed the need for a "well-defined" logistics professional development program. This need for professional logisticians has been echoed by Mosemann. Last year, Mosemann advocated the development of broad gauged professional logisticians through personal study and involvement in professional logistics organizations. (5:6-7) This desire for a well-rounded professional logistician was also suggested by a former Air Force Deputy Chief of Staff for Logistics and Engineering, Lieutenant General Leo Marquez. He believes professional logisticians must understand the synergy of the various logistics disciplines in order to effectively manage the logistics system. (4:10)

In spite of these and other concerns, there still seems to be a lack of definitive direction about civilian logistician career development within the Air Force. While the Air Force Logistics Civilian Career Enhancement Program (LCCEP) was "designed to encourage and manage the development of Air Force civilian logisticians to their fullest potential to meet Air Force mission needs," no consensus definition seems to exist which describes what type of "professional" the Air Force wants in its senior civilian logistician positions. (2:1-1) In fact, LCCEP's Master Development Plans are designed for each logistics job series and reflect rather specialized logistics career ladders. They do not reflect the broad logistics background and professionalism called for by Wade and Mosemann. Therefore, those individuals who aspire to these senior positions are faced with conflicting career development guidance. The day-to-day operation of logistics functions encourages specialized technical expertise at the lower and middle levels, yet the senior positions demand a broad experience base and management expertise. (3:4) To address this issue, research was initiated to describe the characteristics, qualities, and background the Air Force leadership most desired in its professional senior civilian logisticians, to model those components, and to determine how well current senior civilian logisticians fit that model.

The Professional Civilian Logistician Model

After two years of extensive research on the qualifications of senior military logisticians, AFIT initiated research to determine the ideal qualifications for the senior Air Force civilian logistician. The interested reader should read references 1, 7, and 9 for detailed information on the ideal and actual qualifications of senior Air Force military logisticians. In 1986, Donald W. Nancarrow began his research to determine if a model to describe the ideal senior civilian logistician would be similar to Captain Allan D. Overbey's and Captain Adelle R. Zavada's models of the ideal senior military logistician. After interviewing 24 senior military and civilian logisticians, Nancarrow concluded the top levels of the two models were similar, although the relative importance of specific model components would be different. Nancarrow also developed a Delphi survey to be used to identify the specific components which should be included in a model of the ideal senior civilian logistician. (6) Captain Gregor (an author of this article) continued that research in 1987. In the first phase of her research, she revised and administered Nancarrow's Delphi survey to 30 expert senior military and civilian logisticians. These experts were selected from a wide variety of backgrounds to obtain a broad spectrum of expert opinion. Table 1 contains a partial listing of the Delphi experts. The objective of the Delphi method is to reach consensus on an issue. The Delphi method uses sequential rounds, or iterations, of questions until either a consensus is or cannot be achieved. For the purposes of this study, consensus was defined as 60% agreement and two rounds of questions were used. The results from the first round were tabulated and means were computed for each response. Consensus decisions were made, with the non-consensus items forming the basis for the second round questions. Responses and comments from the first round were also provided to the experts in the second round. The consensus responses of these experts were synthesized into a hierarchical, "descriptive" model. The

"DELPHI" EXPERTS	*"WEIGHTING" EXPERTS*
General Bryce Poe II (Ret)	General Alfred G. Hansen**
General Lawrence Skantze (Ret)	Admiral Rowland G. Freeman (Ret)
Lt General Charles C. McDonald*	General Billy Minter (Ret)
Lt General George Rhodes (Ret)	General Earl T. O'Loughlin (Ret)
Lt General Leo Marquez (Ret)	Lt General Joseph M. Heiser, Jr.**
Maj General Lewis G. Curtis**	Lt General Richard Merkling (Ret)
Maj General Charles J. Searock, Jr.	Lt General Marc Reynolds (Ret)
Maj General David J. Teal	Lt General James Stewart (Ret)
Maj General Henry Viccellio, Jr.*	Brig General Stuart R. Boyd
Maj General Monroe T. Smith**	Brig General Richard H. Huckaby
Maj General Graham W. Rider (Ret)	Brig General Clarence H. Lindsey, Jr.**
Mr. James C. Barone, SES	Colonel Harry Gregory
Mr. Benjamin S. Blanchard	Mr. Joseph D. Arcieri, SES (now deceased)
Mr. W. N. Carroll, SES	Mr. Earl W. Briesch, SES
Mr. Gary Flora, SES	Mr. Grover L. Dunn, SES
Mr. Oscar A. Goldfarb, SES	Mr. James Gallagher, SES (Ret)
Mr. Charles Hooper, SES	Mr. Lloyd K. Mosemann II
Mr. Gene L. Mortenson, SES	Mr. Alan K. Olsen, SES
Mr. Anthony J. Pansza, SES	Dr. Robert G. Stein
Mr. Philip P. Panzarella, SES	Mr. Boyd T. Thurgood, SES
Mr. Jerome G. Peppers	Mr. Edward R. Zschiesche, SES
Mr. George Reustow, SES	

* Have since been promoted
** Have since retired

Table 1: Partial Listing of Research Experts.

resulting model is displayed in Figure 1. The model has three dimensions: Experience, Education and Training, and Professional Attributes. These dimensions are further broken down into more specific categories and even more specific elements.

A purely descriptive model would not be a valid tool for objectively evaluating an individual's professional qualifications, nor would it be an effective guide for career development without some form of prioritization of the model components. Therefore, a "weighted" model was developed during the second phase of the research. The descriptive model was weighted by 40 expert senior logisticians. A partial listing of the weighting experts can be seen in Table 1. These experts were asked to assign a total of 100 points to the three model dimensions, according to their relative importance. They were then required to do the same with each of the model category and element groupings. Using their mean responses, a weighted model was developed using a 100 point scale. Experience was deemed most important by the experts, with a mean weight of 40 points. It was followed by Professional Attributes, weighted 35 points, and Education and Training, weighted 25 points out of 100. The model category weightings are shown in Table 2. Further information on the weighting survey results can be found in reference 3.

The first two phases of this research provided a weighted model based on the opinions of some of the best logistics minds available. Before that weighted model was used to evaluate the professional qualifications of senior civilian logisticians, it was validated through a survey sent to all Air Force GM-15 logisticians. The validation respondents were asked many of the same questions the Delphi experts were asked. The goal of the survey was to determine if the GM-15 logisticians agreed that the model dimensions and categories described the professional qualifications of the ideal senior civilian logistician. The GM-15 respondents agreed on the relative importance of the model dimensions; they believed Experience was most important, followed by Professional Attributes and Education and Training. They also agreed that all but two of the model components should be included. The GM-15 logisticians did *not* believe mobility and a master's degree should be firm requirements for selection to senior positions. Since the senior logistics "experts" felt these were important qualifications, they were retained in the validated model.

Model Criteria

To compare how well the current senior civilian logisticians fit the weighted model, data on each GM-15 were obtained through the validation survey. The respondents were asked several questions to determine whether they possessed the qualities and qualifications outlined in the weighted model of the professional senior civilian logistician, which will be called the AFIT Civilian Model. They were allocated points according to the weights assigned to each component of the AFIT Civilian Model.

To eliminate subjective scoring, a dichotomous scoring system was used with no partial credit given. Either the individual possessed the quality or qualification or he/she did not. The scoring rules were based on the Delphi experts' recommendations. Most criteria were self-explanatory. Those that require explanation are as follows:

(1) **Assignments in Logistics.** Respondents received credit for experience in each of the logistics disciplines. If they had experience in wholesale logistics and at least one other discipline, they received full credit for experience in the logistics disciplines. The respondents received credit for an assignment in an operational command if they had experience in any Air Force operational command or prior operational military experience in any service.

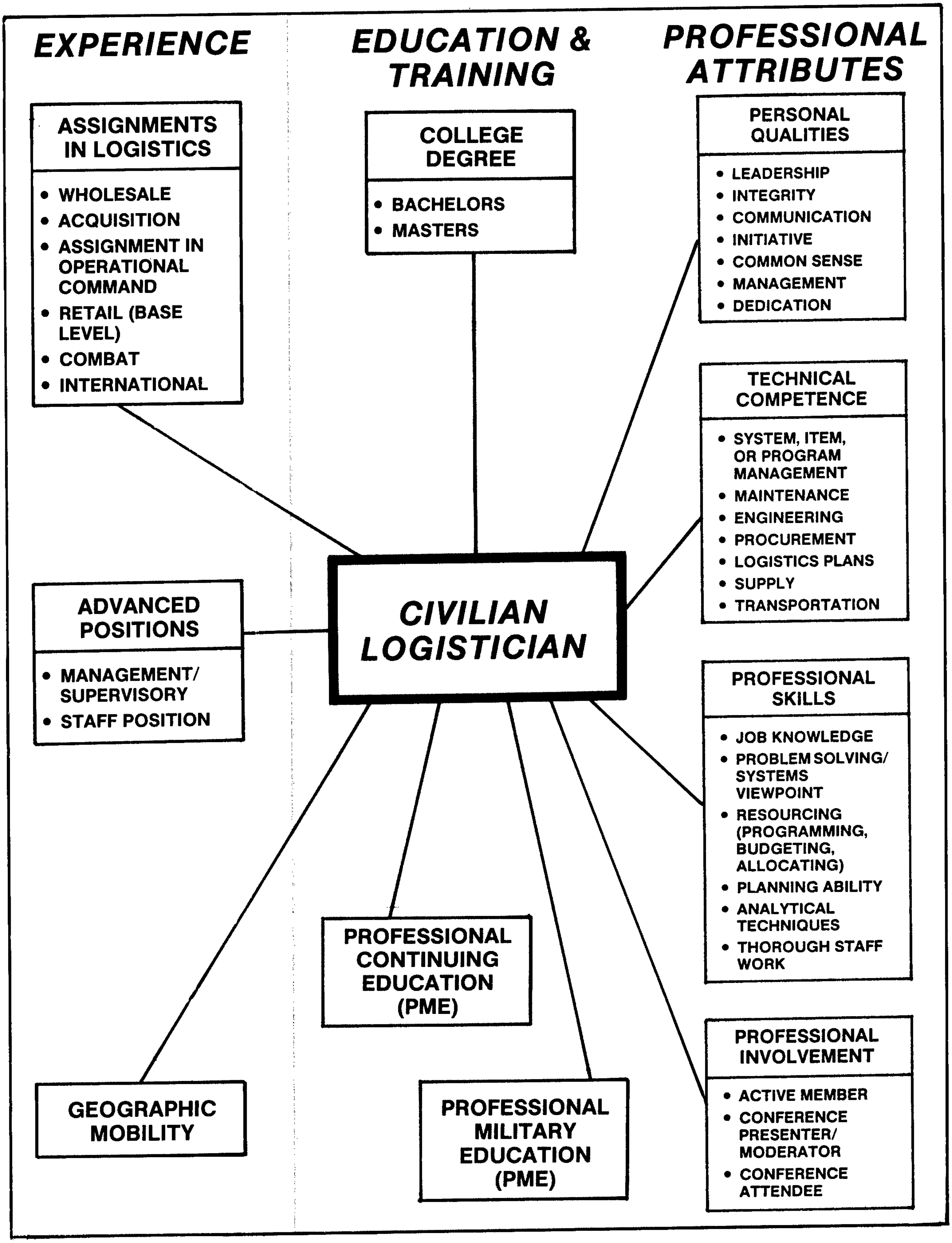

Figure 1: AFIT Civilian Model.

Category Weightings		
DIMENSION	CATEGORY	CATEGORY WEIGHTS
Experience (40.0)	Assignments in Logistics	18.8
	Advanced Positions	13.8
	Mobility	7.4
Professional Attributes (35.0)	Personal Qualities	11.5
	Technical Competence	11.0
	Professional Skills	8.5
	Professional Organizations	4.0
Education and Training (25.0)	College Degree	11.9
	Professional Continuing Education	8.5
	Professional Military Education	4.6

Table 2: Civilian Model Category Weightings.

(2) **Advanced Positions.** The Delphi experts believed 70% of an individual's experience in advanced positions should be obtained in the logistics career field, so this threshold was the cutoff point for credit in this category. Additionally, the individual must have held one management or supervisory position to receive credit for that element. They must have served at the division level or higher to receive credit for the staff position element.

(3) **Mobility.** Respondents received credit for mobility if they had made two or more geographic moves.

(4) **Personal Qualities.** To obtain objective differentiation between the GM-15 respondents who probably possessed all the qualities to some degree, a relative scoring system was developed. The respondents were required to allocate 100 points among the model's personal qualities and any they chose to write in, based on the relative degree to which they possessed those qualities. They received credit for a quality if their personal weighting was greater than or equal to the mean weighting for all respondents.

(5) **Professional Skills.** This category was scored in the same manner as the personal qualities category.

(6) **Technical Competence.** Respondents received credit for technical competence in a particular logistics function if they rated themselves "fairly competent" or better (the midpoint of a five point Likert scale). They received credit for the entire category if they were technically competent in system/item/program management and two other functional areas.

(7) **Professional Continuing Education (PCE).** Respondents received credit for completing any PCE course.

(8) **Professional Military Education (PME).** Respondents received credit for any course except Squadron Officer School.

Once individual model scores were computed, the Kruskal-Wallis H test and the t-test were used to determine whether selected factors accounted for the differences in individual model scores. Additionally, cutoffs for high and low scorers were set at the top 20 and bottom 20 scores. There are about 20 SES positions in the logistics career field, so it is likely that those individuals whose model scores fall in the top 20 will be top contenders for SES positions. Those respondents whose scores fell into the bottom 20 were also examined to see where their strengths and weaknesses lay and as a means of comparison.

Today's Senior Logisticians

A survey was sent to all 166 Air Force GM-15 logisticians. The 78% response rate was deemed to be both sufficient and representative of the entire population of GM-15 logisticians. As a group, the GM-15 respondents did not "fit" the ideal model very well; that is, they did not meet all the ideal senior civilian logistician qualifications. Their mean model score was 67.3 points, out of a possible 100, with a standard deviation of 11.0. Their scores ranged from a high of 91.1 points to a low of 39.6 points. The distribution of model scores is shown in Figure 2. The GM-15 qualifications in each of the three model dimensions will be discussed next.

Experience

The GM-15 respondents were well qualified in all experience categories except mobility. Only 44% of the respondents met the mobility criteria of two or more moves, and 37% had never moved. In spite of this, 11 respondents received the maximum experience score of 40 points. Almost 97% of the respondents had experience in wholesale logistics, and 76.4% had experience in acquisition logistics. However, only about one-third had experience in an operational command. The percentage of respondents receiving credit in each of the dichotomous model elements is displayed in Table 3. The GM-15 respondents had a wealth of experience in advanced positions. Over 81% received credit for management and supervisory experience, and 76.4% were credited with staff experience.

Professional Attributes

The GM-15 respondents generally did not score well in the professional attributes dimension. The mean score for this dimension was 21.1 points out of a possible 35.0. No one

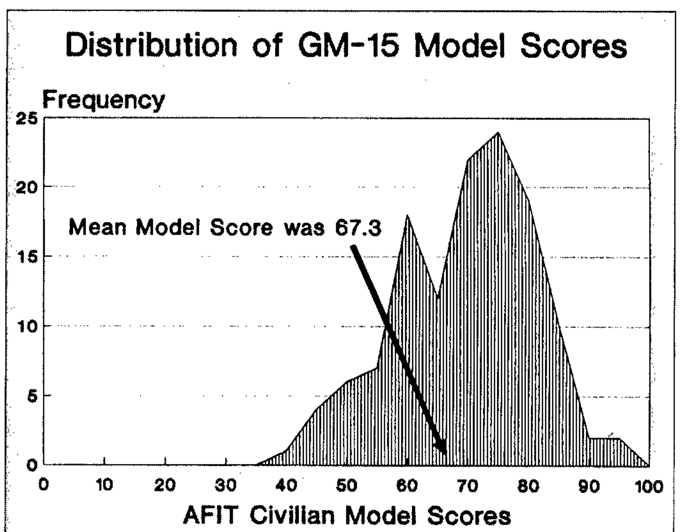

Figure 2: Distribution of GM-15 Model Scores.

received a perfect score in this dimension due, in part, to the relative scoring system for professional skills and personal qualities. The respondents' mean score for professional skills was 4.5 points out of 7.4 points possible. Their mean score for personal qualities was 5.1 points out of 11.5. These figures suggest that many of today's senior civilian logisticians do not believe their strengths lie in the areas deemed most important by the Delphi experts.

The GM-15 respondents, as a group, did not have high levels of participation in professional logistics organizations. While half had attended a conference, seminar, or symposium at one time, very few had higher levels of participation (Table 3).

In spite of these weaknesses, the respondents possessed a high degree of technical competence. All but 12 respondents met the criteria for a perfect score in this category; that is, they rated themselves technically competent in system, item, or program management and two other logistics functional areas. As shown in Table 3, most were competent in system, item, or program management and logistics plans. Almost 80% were competent in maintenance.

ELEMENT	PERCENTAGE
Wholesale Logistics	96.9
Acquisition Logistics	76.4
Assignment in Operational	29.1
Retail Logistics	29.9
Combat Logistics	32.2
International Logistics	44.9
Management/Supervisory Position	81.1
Staff Experience	76.4
System/Item/Program Management	96.9
Maintenance Competence	78.0
Engineering Competence	52.8
Procurement Competence	58.3
Logistics Plans Competence	94.5
Supply Competence	69.3
Transportation Competence	44.1
Active Member - Professional Logistics Organization	19.7
Conference Presenter/Panel Leader Moderator	28.3
Conf./Seminar/Symposia Attendee	50.4
Bachelors Degree	91.3
Masters Degree	52.0

Table 3: Dichotomous Element Frequencies.

Education and Training

As a group, the GM-15 respondents were not well qualified in the education and training dimension. Their mean score was 16.9 points out of a possible 25.0. However, 26 individuals received the maximum score possible. Over 90% of the respondents possessed a bachelor's degree, and 52% had earned a master's degree. In addition, 71.7% had completed a PCE course. Only 39.4% had completed a PME course equivalent to Air Command and Staff College or higher.

Differences in Model Scores

Three factors were examined to determine whether they accounted for the differences in individual model scores. It was hypothesized that respondent job series might account for the differences in scores. The Kruskal-Wallis H test was performed to test for a statistical difference in mean scores. Due to the small number of individuals in some of the job series, some series were grouped together. The supply job series (2003 and 2010) were grouped together. All the 2100 series were grouped with the 1101 and 1910 job series. The tests showed no significant differences in mean model and dimension scores for the different job series. Today's senior civilian logisticians appear to be equally qualified across the different job series. For the specific results of these tests, see reference 3.

Next, the data were tested to determine whether generalists scored higher than specialists. The respondents were asked whether depth or breadth of experience was more important for the person who would replace them in their current job. Those who answered depth of experience were classified as "specialists," and those who answered breadth were classified as "generalists." Using the t-test, no significant differences were found in mean model or experience scores for the two groups.

Finally, the data were examined to determine whether an individual's mobility status accounted for differences in scores beyond the 7.3 points which could be credited to those who had moved two or more times. It was hypothesized that those who were mobile would have higher levels of experience. Using the t-test, no significant differences in model and experience scores existed between those who were classified as mobile and those who were not. The Kruskal-Wallis H test was also performed to determine whether mean model scores differed according to the number of moves the respondents had made. Again, no significant differences were observed. However, some differences became evident when the qualifications of the 20 respondents with the highest model scores were compared to those of the 20 respondents with the lowest model scores.

The "Top" Twenty

The top 20 GM-15 logisticians were well qualified based on their "fit" to the AFIT Civilian Model. Their scores ranged from 77.9 to 91.1 points. Many of them scored exceptionally well in the model dimensions; 6 attained a perfect experience score and 12 attained a perfect education and training score.

These individuals came from a wide variety of job series, including some of the more traditionally specialist-oriented job series such as transportation. They were well qualified in the experience dimension and had served in more than one logistics discipline. Accordingly, 15 had moved two or more times. All had wholesale logistics experience, 18 had acquisition logistics experience, 12 had combat logistics experience, 12 had international logistics experience, and 7 had retail logistics experience. All of them met the criteria for experience in advanced positions. However, only half of these individuals had experience in an operational command.

The top 20 GM-15s did not score well in the professional attributes dimension. Part of the reason for their low scores is the relative nature of the scoring for professional skills and personal qualities. The top 20 GM-15s did score higher than average in those two categories. They were also highly technically competent. Nineteen rated themselves as competent in system, item, or program management. Nineteen also rated themselves as competent in logistics plans. Eighteen were competent in supply, 16 in maintenance, 12 in procurement, 9 in transportation, and 9 in engineering. They were weak in their levels of participation in professional logistics organizations. Only five were active members of a professional logistics organization. Fourteen had attended professional conferences, seminars, or symposia, and eight of those individuals had also served as presenters, moderators, or panel leaders.

The top 20 GM-15s scored high marks in the education and training dimension. All possessed a bachelor's degree and 16 had earned a master's degree. All of them had completed some sort of PCE, and 16 had completed a qualifying PME course.

The "Bottom" Twenty

The bottom 20 GM-15 logisticians did not score well based on the AFIT Civilian Model criteria. Their scores ranged from 39.6 to 56.8 points. Like the top 20 GM-15s, they also came from a wide variety of job series. However, they did not possess a broad base of experience. Eighteen of them had experience in wholesale logistics, 10 in acquisition logistics, 5 in combat logistics, 4 in retail logistics, and 4 in international logistics. Most of them did not meet the criteria for experience in advanced positions as they had not performed these duties primarily in logistics. Only 5 of the bottom 20 GM-15s had experience in an operational command. Only five of them had moved two or more times, and nine had never moved.

The bottom 20 GM-15s did not score well in the professional attributes dimension. Their scores for professional skills and personal qualities were lower than the average for all GM-15s. Their involvement in professional logistics organizations was very low. Only one was an active member; three had attended conferences, seminars, or symposia; and only one had served as a presenter, panel leader, or moderator. On the other hand, like the top 20 GM-15s, they were highly technically competent. In fact, 16 of the bottom 20 GM-15 logisticians attained perfect scores in the technical competence category. Nineteen of them rated themselves as technically competent in system, item, or program management. Eighteen rated themselves competent in logistics plans. Fourteen were technically competent in supply, 12 in maintenance, 10 in procurement, 10 in engineering, and 8 in transportation.

The bottom 20 GM-15 logisticians did not score well in the education and training dimension. Sixteen of them had earned a bachelor's degree, and nine had earned a master's degree. Seven had completed a PCE course. Only six of them had completed a qualifying PME course.

Conclusions

The data suggest that, as a whole, today's senior civilian logisticians do not possess the ideal professional qualifications to manage the complex Air Force logistics systems. Their average model score of 67.3 points does not reflect a strong "fit" to the qualities and qualifications outlined in the ideal AFIT Civilian Model. However, those GM-15 logisticians who attained the top 20 model scores appear very well qualified to assume the responsibilities of Senior Executive Service logistics management and leadership. The question for the Air Force leadership to answer is "Is that enough?"

This research provides valuable information for those who are interested in the career development of senior civilian logisticians. Although the research did not discover any specific factors which accounted for the differences in individual model scores, the comparison of the top 20 and bottom 20 GM-15 logisticians provides some insight into the factors which distinguish the top scorers from their peers. Those who scored highest were involved in those activities which broaden a logistician's outlook. Almost all of today's senior logisticians possess a high degree of technical competence. They have a strong base of experience in logistics. They have a proven record of job performance that has allowed them to reach their present positions. Those who came closest to the ideal have gone beyond those basics. They are being exposed to new ideas through their involvement in PCE, graduate education, and professional logistics organizations. They are being exposed to the needs and requirements of logistics and weapon system users through operational assignments and PME. They are being exposed to an array of diverse "corporate cultures" and management situations through their geographic mobility. In short, they are doing those things Mosemann recommended for the development of logistics professionals. They are accumulating the experience and knowledge which will help them manage the total logistics system as an integrated whole.

The results of this research also suggest the areas in which logistics career development programs must focus their attention. LCCEP should attempt to develop broad gauged logistics professionals by strengthening potential senior logisticians in each of the three model dimensions. A caveat is necessary here. The qualifications of today's senior logisticians may not reflect LCCEP's effectiveness, for many of LCCEP's programs have come too late to benefit the senior civilian logisticians occupying GM-15 positions today. As retired Lieutenant General Leo Marquez wrote in his reply to the second round Delphi Survey:

> The early history of LCCEP [was] painful, as so much resistance to the concept existed and so many obstacles were raised to its implementation. What we had was a career progression pattern which was essentially random, with chance playing more a part in professional development than purpose. There was not then and, now only [in] 'rudimentary form,' any attempt to describe what a senior 'loggie' should have under his belt in terms of job experience, training, or education. The typical civilian, then, tended to spend his entire career in one discipline, i.e., maintenance, supply, material management, distribution. They are, as I have described them, ten feet tall and two inches wide. The robust six footer is rare—very rare. (3:265-266)

While LCCEP has developed programs designed to develop the "robust six footer," further research is necessary to determine whether these programs are effective in developing professional logisticians.

The answer to the question posed by the title of this article is "yes"; the Air Force does have "some" highly qualified professional senior logisticians. Two questions remain:

(1) Are there enough?

(2) Are you or will you be one of them?

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Correction for "Unscheduled Maintenance Dispatching: Simple and Effective Decision Rules" Spring 1989 issue)

The Spring 1989 issue of the *Air Force Journal of Logistics* contained an article by Major Jacob V. Simons, Jr., entitled "Unscheduled Maintenance Dispatching: Simple and Effective Decision Rules." In this article, Major Simons demonstrated dispatching rules which can be used to achieve three different goals. The rules presented and the schedules produced by those rules were correct. However, the author inadvertently displayed incorrect values for the example average completion times and hours late in three tables and one figure. Specifically, Figure 1 is correct except that the average completion time shown at the bottom of the figure should be 12.9 hours. The corrected tables are shown. It should be noted that the correct values reflect even more dramatic improvement produced by the dispatching rules than the values originally shown. The author regrets any confusion caused by this oversight.

Schedule	Average Job Completion Time
A,B,C,D,E,F,G	15.4
B,C,D,E,F,G,A	18.0
C,D,E,F,G,A,B	17.6
D,E,F,G,A,B,C	21.1
E,F,G,A,B,C,D	17.7
F,G,A,B,C,D,E	18.3
G,A,B,C,D,E,F	19.9

Table 2: Average Completion Times for Various Schedules.

SPT Schedule	Hours Late	EDD Schedule	Hours Late
C	-14	A	-10
A	-9	G	-1
F	-14	C	-3
E	-13	D	3
B	-6	F	3
D	6	B	7
G	20	E	9
Max. tardiness (G): 20		Max. tardiness (E): 9	

Table 4: Minimizing Maximum Tardiness.

SPT	Hours Late	EDD	Hours Late	Moore's Rule	Hours Late
C	-14	A	-10	A	-10
A	-9	G	-1	C	-12
F	-14	C	-3	D	-6
E	-13	D	3	F	-6
B	-6	F	3	B	-2
D	6	B	7	E	0
G	20	E	9	G	20
Late jobs: 2 (D,G)		Late jobs: 4 (D,F,B,E)		Late jobs: 1 (G)	

Table 5: Minimizing the Number of Late Jobs.

QUALITY CONSTRUCTION - Can We Obtain It?

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Quality has been the byword for the 1980s and will continue to be in the 1990s. Manufacturers are pushing the quality of the finished product as the prime value. Ford, as heralded by many commercials, declares "Quality is Job 1." Many courses in colleges and continuing education are specifically designed to provide quality in the manufactured product. Many new methods of manufacturing are geared toward ensuring quality of the final product. A national award for quality has been established because "Quality is the key weapon in America's arsenal in the international battle for markets," according to United States Commerce Secretary William Verity. (13:1)

Consumers are more value oriented, not just price conscious. They select and purchase many goods over others because the quality of the product is considered greater. The American manufacturing community is greatly concerned because of the perceived high quality of Japanese-made goods. The Japanese system of manufacturing has as one of its basic tenets, the quality of the product. Will this same fervor for quality be carried over into the construction arena?

In the past few years, this need for quality in the construction industry has become the key issue at several conferences. In 1984, the American Society of Civil Engineers (ASCE) held a conference in Chicago to discuss "Quality in the Constructed Project." Even at this late date in the history of construction activities, no adequate definition of quality could be stated. (11:217) A joint meeting between the National Science Foundation and the ASCE in May 1982 at the University of Michigan established, as one of the basic needs for research, a definition for quality and a responsibility designator for quality. Who is responsible for quality and how can quality be identified? (2:183)

Construction is unlike the manufacturing process and must be understood before trying to define quality and responsibility. Some important characteristics distinguish construction from other industries:

(1) Each project is uniquely constructed at a different location, using different products, different skills, and different methods.

(2) Each project has a separate work force. The various stages are accomplished by different trades with work groups seldom being the same.

(3) Each project has its own completion schedule. Task completion times vary as do total project lengths.

(4) Each project usually has a different set of subcontractors leaving the project superintendent with little control over the subcontractor's personnel.

(5) Each construction company has a distinct organizational structure, sometimes making communication difficult.

With these unique factors, quality control has been difficult to implement in the construction industry. (5:430-431)

Definition of Quality

Since no formal written definition of construction quality is accepted by all groups, a proper place to start is to define quality so a standard for comparison is available. Quality must be consistent throughout the entire project, thus becoming everyone's responsibility. In other words, it is a team effort, from the owner to the craftsman. (11:216) Quality is conformance to a standard (8:176) and must include time and cost as a part of that definition. (4:163)

Quality is both a product and a process according to a 1987 Logistics Management Institute report, "Contracting for Quality Facilities," by William Moore and Trevor Neve. (9:2-1) Both are perceptions, but these perceptions can be tied to something more definite. The quality product is maintainable and functional, appeals to the user, and satisfies the user's requirements. The quality process indicates that scheduling and cost targets were met, all done with minimal inspection and administration. (9:2-2) This definition draws together the design, the inspection, and the construction. The characteristics of the design identify the economical, functional, and aesthetic qualities of the products. The contractor physically puts the products together to conform to the stated quality standard without the inspector trying to inspect in quality. "Quality of design and quality of conformance determine the quality of the constructed project." (1:315)

Quality takes teamwork. As such, each member must understand his/her responsibilities to the project and accept those responsibilities to the full intent of the definitions.

Responsibilities

Government

The government must take the lead in requiring quality, starting from project inception through the maintenance requirements of each facility. Since quality costs money, sufficient funds must be identified from the very beginning to ensure quality construction. Cost can impact quality work, as much, if not more, than any other factor. (3:78) Sufficient time must be allowed for a proper design to occur instead of a last-minute crunch to obligate funds at the end of the year.

Designer

Once again, the government can take the lead by insisting on quality design. Design errors, omissions, vagueness, and ambiguities all impact the ultimate quality of the facility. "Quality of the engineering design and of the specification are basic to obtaining a quality project." (3:72) In his book, *Professional Construction Management*, Donald Barrie states that quality of design is one aspect of the quality facility. Specifying cheap, failure-prone products which will have a lower first cost can increase long-run (life cycle) facility costs. (1:314) Keeping architectural and engineering fees low can also

Quality construction considers the details of the project.

affect the final design. The 6% Title 1B design limitation can lead to an architect/engineer (A/E) cutting costs to ensure a profit. Since quality is product-oriented, the designer must specify the quality required to assure a functional, economical, and aesthetic facility. Quality must start by clearly defining what is acceptable and how it is to be verified. Year-end funding and the $200,000 minor construction limitation can have a noticeably negative effect on quality as designs are rushed and estimates lowered to meet the year-end time frame for funds expenditures.

Procurement

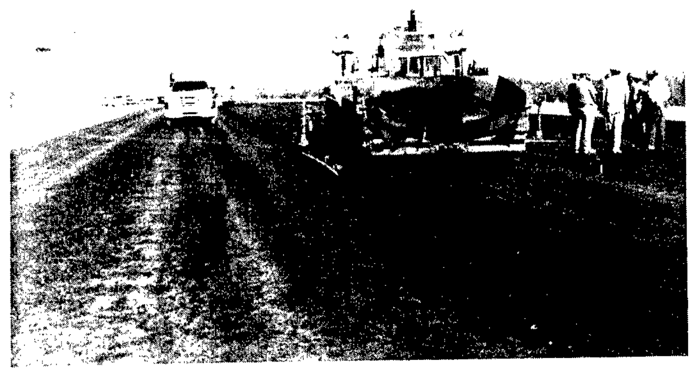
One of the major factors contributing to the success of a facility project is the type of contract used to procure the facility. (9:2-4) All but a very few construction contracts are firm, fixed-price contracts, which in theory motivate the contractor to use management ingenuity to maximize profits. Quality conflicts can occur when the low bidder is the required choice, since the low bidder may sacrifice quality for economy in production. (3:74) The government requirement that award be made to the lowest "quality bidder" assures that quality may suffer on many of its projects. When the bidding competition is tough, the adverse effect on quality increases considerably since the motivation for the contractor is dollars. (14:171) Price should not be the only qualification for the successful bidder. A study assessing the impact of contract clauses on construction found fixed-price contracts build in an adversarial relationship on quality. (7:509)

Inspection

Once the A/E has set the criteria for construction based on government standards, quality control ensures the physical work conforms to the standards. (1:313) The inspectors' job is to identify discrepancies. As a result, inspectors, more than anyone else, may directly and quantitatively define the quality of the final project. Since the inspectors represent the design team during construction, the abilities of the inspectors will determine whether or not the quality control program is effective. (10:515-516) Inspectors are the eyes and ears of the government during construction. Their skills and abilities in communicating and working with people will either enhance or destroy the quality of the project. People produce quality work rather than inspections or records. Poor quality is detected by inspection; but except for new work, it can only be corrected by changing attitudes and skills. (3:77)

Contractor

Even with all the partnership required to produce a quality facility, contractors provide and are responsible for quality control. (12:314) The prime contractors, as sole parties to the contract who have direct control over the construction, have the duty to perform in accordance with the plans and specifications. Being profit-oriented, however, they could put profit before quality. Contractors will ensure quality only if personally dedicated to that end through the people hired and the policies administered. No substitute exists for careful staffing on a construction project with a conviction to ensure quality. Contractors must insist on "building in" instead of trying to "inspect in" quality in each project. (11:218) The real test for quality construction is applied when the start-up crews begin testing systems to ensure proper functioning since quality requires little rework. (3:78) The degree of conformance by the contractors can be summarized by evaluating the field-construction methods (the skills of the workers, the quality of materials used, and the equipment used), the supervisory and managerial control (who is running the job and how is conformance to plans and specifications encouraged), and the inspection (the quality control procedures used to verify the conformance to the project requirements).



Quality construction ensures the right equipment for the job.

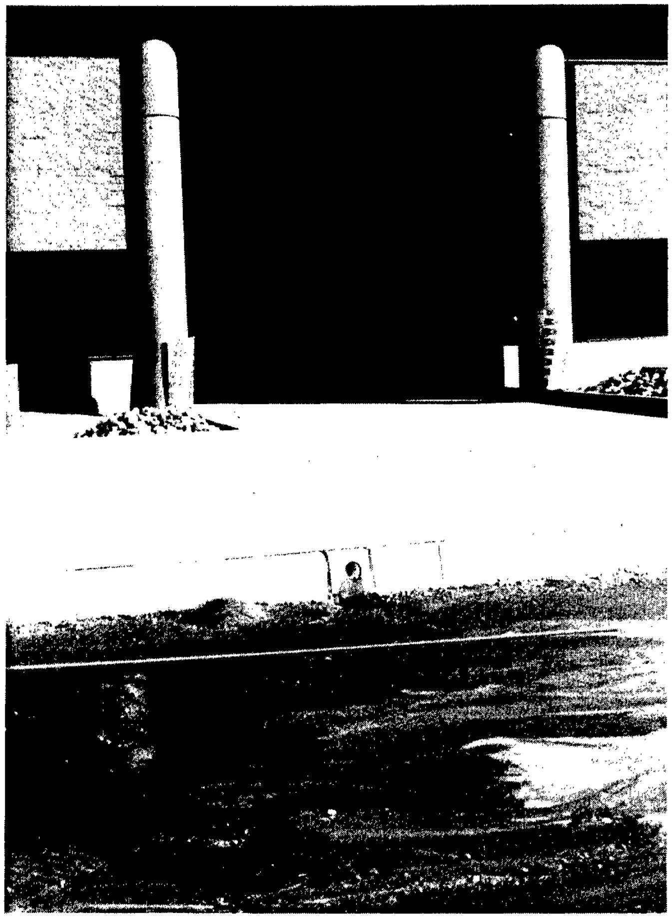
Recommendations for Quality in the Constructed Facility

The following recommendations will ensure better quality in constructed facilities:

(1) The government must decide on a definition of quality that can be supported at all levels. Determining quality by price alone will continue to foster problems similar to those now evident on many construction projects. The constraint of year-end funding must also be eliminated. Better quality would be obtained if the year-end funding time constraints were removed and a construction and repair budget were established. Funds would be obligated as the designs are accomplished instead of in a last-minute year-end flurry to obligate funds in the operation and maintenance (O&M) program. If we are really interested in quality, our focus and attitudes must change.

(2) Programming of projects must include sufficient funding that will not be decreased in an attempt to lower the budget. This would mean better preliminary estimates required to capture the quality intended. Part of this programming process would

require increasing the minor construction limitation above $200,000 and eliminating the year-end time constraints for the expenditure of funds for the O&M program. The minor construction limitations has not kept up with inflation in the construction industry.



Quality Design? This roof drain empties on the VIP parking space.

(3) Increase design fees to cover legitimate design costs to ensure quality designs. Design standards must be adhered to by the A/E and they must accept responsibility for design errors. We might even consider incentive fees for the A/E based on lack of amendments required during bidding or modifications during construction due to design errors and omissions. Various studies have indicated that 40% of contractor claims are for defective designs. (6:184) Year-end funding and time constraints for O&M projects ensure defective designs because review time is not available to check for design quality. Time for performance must also be available instead of shortening design time due to the imposed constraint of the disappearance of funds at the end of the year. Prior year O&M funding seems to be available to do project changes instead of doing the design right the first time. The attitude for quality must be evident during design.

(4) Procurement of construction must shift from the low bid criterion. Modifying the contracting procedure to use incentives for performance and deleting the negative aspects could help eliminate the adversarial role. Devising a rating scale with several factors, including price, as a scoring vehicle for awarding contracts could produce a "most qualified" bidder. Other factors could include technical competence, organizational structure, prior satisfactory work, overhead costs, quality control plans, and the experience of the superintendent. This totally qualified bidder would possess all the attributes needed to become a partner in constructing a quality facility.

(5) Consider incentive award fees as another option. This program could include a graduated scale that reverses the liquidated damages provision and pays a contractor an incentive fee for each day of an early performance up to a maximum amount. A fee could also be established for quality work to include incentives for lack of defects. Part of this plan must include a provision for the worker to benefit from the incentive, not just additional profit for the contractor. It is imperative to motivate the workers and change the attitudes of the craftsmen to produce quality.

(6) To promote excellence in construction, provide incentives for construction engineers and inspectors to become registered or certified by recognized agencies. Government engineers and technicians are encouraged but not motivated to seek registration. Doctors and lawyers are recognized for their registration and are duly compensated. Engineers should also be recognized if we are to attract qualified personnel who can help obtain the quality facilities needed to support the Air Force mission. Most inspectors are paid less than any craftsman on the job, yet they must know as much as the craftsman of each trade to recognize nonconformance. Scaling the inspectors' pay grade to a degree of knowledge instead of the types of jobs inspected could motivate the inspectors to a more professional level.

Summary

Quality in the constructed project is the goal of most individuals in the engineering and construction community. Unfortunately, many of the systems we operate are not conducive to that goal. By eliminating the adversarial role created through the procurement and inspection system and by providing adequate incentives to perform, quality can become that standard instead of the goal.

Quality will only be realized when all members of the design and construction team understand and accept their responsibilities. Now is the time to start teaching and training all the members involved in the construction community that quality comes from within, not from without. Attitudes and philosophies must be changed for everyone to "do it right the first time."

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Performance Support Tools: Part of the Quality Work Force Equation

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Quality management seems to be the touchstone of American business today. Phenomenal success stories abound about implementation of quality improvement programs. (11) There are books, seminars, magazines, and journals dedicated solely to the topic of quality improvement. There are quality gurus such as Deming, Juran, Crosby, and Taguchi. Many businesses have created slogans such as "Quality is job 1" and "The quality goes in before the name goes on." American business has finally realized that continuous quality improvement in products and services is critical for survival in the global marketplace.

There is even a national quality award named for the former Secretary of Commerce, Malcolm Baldrige. The Baldrige Award was established in 1987 by national legislation to recognize businesses which are exemplars of quality improvement. To date, five companies have won the award: Globe Metallurgical, Inc.; Motorola; Commercial Nuclear Fuel Division; Westinghouse Electric; Xerox Corporation; and Millikin & Company. These five companies have one thing in common: they have demonstrated that quality improvement efforts do improve efficiency, productivity, and customer satisfaction, and do pay off in the profit column. (14)

In the Department of Defense, the quality improvement movement has been labeled Total Quality Management or TQM. In 1988, the Secretary of Defense signed the "Department of Defense Posture on Quality" memorandum and thereby initiated the TQM program. (9) The TQM program affects everything the military does, produces, or procures. The dominant theme is a commitment to quality and continuous improvement.

The Air Force has also embraced the TQM concept as a fundamental philosophy for eliminating waste, removing bottlenecks, improving customer support, and reducing costs. No command has more aggressively pursued this concept than the Air Force Logistics Command (AFLC). No one has been more vocal about AFLC quality than General Alfred G. Hansen, former AFLC Commander. He said, "We (AFLC) can't afford to pay the high cost of continually correcting deficiencies by trying to inspect in quality at the end of the process." (5:10) For this reason, AFLC has broken with the traditional methods of quality control. In their place, AFLC has instituted a quality program which combines four main components—people, process, performance, and product. Figure 1 is a graphical depiction of this concept.

The AFLC quality slogan is QP4. QP4 is defined as:

Quality = People + Process + Performance + Product

It represents a commitment by top management to total participation by everyone in the process of improving the logistics business. Ultimately, it is about working smarter and capitalizing on new opportunities to effect positive change. One such opportunity is the application of performance support tools. These tools assist in the human performance process which is the integration of three of the four major components of AFLC's quality program. They promise to improve the logistics product by helping our people perform their jobs better. This paper examines the concept of performance support tools and presents logistics examples of these tools. But before examining the performance support tool concept, it is important to define the human performance process and how these new tools assist in that process.

Human Performance

Human performance is the accomplishment of some task. In the case of a logistician, it is that set of activities that gets the right item to the right place at the right time to meet mission requirements. Evans (4) says three variables affect an individual's performance: ability to do the job, motivation to do the job, and external factors that facilitate or constrain task performance. It is interesting to note that the process orientation of TQM is designed precisely to focus on this third variable. Deming argues quite convincingly that the work process, not the individual, is to blame for most of an organization's quality problems. In fact, AFLC has found that about 80% of the quality problems they have identified were due to process deficiencies. (5)

QP4 CONCEPT

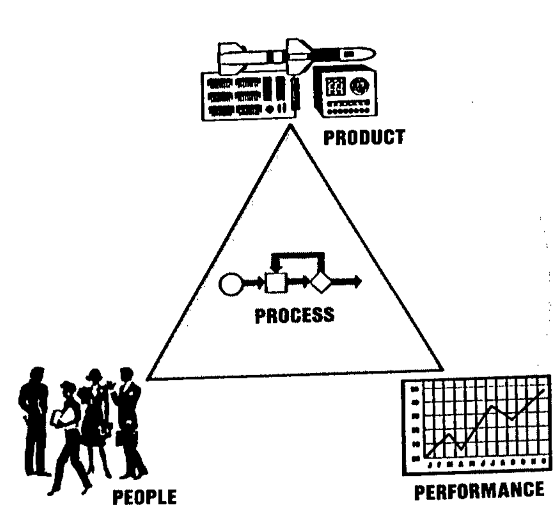

Figure 1.

On the other hand, the first two variables are classic human performance elements. In 1964, Vroom (13) put forth the following basic conceptualization of the determinants of human performance:

$$\textbf{Performance} = f\ \textbf{(Ability x Motivation)}$$

Licker (7) labels the *ability element* as the capacity to perform the task and the *motivation element* as the will to perform the task. Without the will or the capacity, human performance will be reduced.

The motivational element of this equation has been extensively studied by behavioral scientists. In general, motivational research has examined both the internal (locus of control) and external (reinforcement theory) dimensions of motivation. In addition, goal setting, accountability, and participation have also been studied as they relate to motivating human performance.

While these studies have identified important motivational factors which affect human performance, all the experts in motivation research recognize the importance of ability in the human performance equation. Ability is the capacity to either perform some specific behavioral task or the capacity to perform some specific cognitive process which is functionally related to some particular task. Operating a computerized information system such as the Core Automated Maintenance System, delivering mission critical parts to the flight line, or driving an Air Force bus are all examples of behavioral tasks which require specific motor activities. On the other hand, writing a service contract, planning a mobility deployment, or testing jet engine fuel samples are all cognitive processes which require specific cognitive activities. In both illustrations, ability is conceived as comprising three components: (1) the existence of a domain-specific knowledge base, (2) a method for accessing this knowledge base, and (3) the capacity to enact a set of behaviors or cognitions using the retrieved knowledge to perform the specific task.

The third component is what people observe and label as ability. Actually, the first two components are indispensable prerequisites to the actual execution of the observable actions. For example, without a set of rules and facts about storing material in a warehouse (a warehousing system knowledge base), an individual could not demonstrate the observable behaviors which would allow an independent observer to infer that the individual had this specific ability. Likewise, an individual may possess the knowledge, but not be able to access the knowledge, so an independent observer would infer that the individual did not have a specific ability. For example, a maintenance technician may know that the master circuit breaker provides the power for the lights and the drill press in the sheet metal shop, but the technician may be unable to recall where the master circuit breaker is located in the building. Having a domain specific knowledge base and a method for accessing the knowledge are then critical to applying this knowledge to the specific work situation at hand.

In the past, most job knowledge and the accessing methods resided internal to the individual. As the logistics work environment became more complex, it also became increasingly difficult for logisticians to internalize all the knowledge they needed so they could perform their jobs effectively. This increasing complexity drove the Air Force (and others) to job specialization which reduced the amount of information individuals needed to perform their jobs.

Job specialization creates two new problems. First, it increases labor cost and fragments the knowledge base. It also increases the human communication requirement to complete a specific task. Rather than reducing complexity, the job specialization solution actually increases complexity. Today with new computer technology and software capabilities, products can be developed which provide direct support to human performance. This new class of support system is called a performance support tool. It can assist individuals with both the knowledge storage and the knowledge retrieval process, thereby freeing them from the onerous task of having to remember all the information they need to perform a given task. Instead, performance support tools allow the individual to concentrate on applying the knowledge to the specific task. By so doing, performance support tools assist in improving the quality of human performance. The next section of this article examines this new class of computer software.

Performance Support Tools

Performance support tools are integrated electronic environments designed to improve worker productivity by providing immediate on-the-job access to an interactive knowledge base, learning opportunities, and expert consultation with the scope and sequence controlled by the user. (10:2) What is fundamental to the concept is this integrated information system is available to the workers when they need the information and in the form they need it. Conceptually, performance support tools consist of three primary components. As seen in Figure 2, these three components are interactive documentation, an expert system, and learning support.

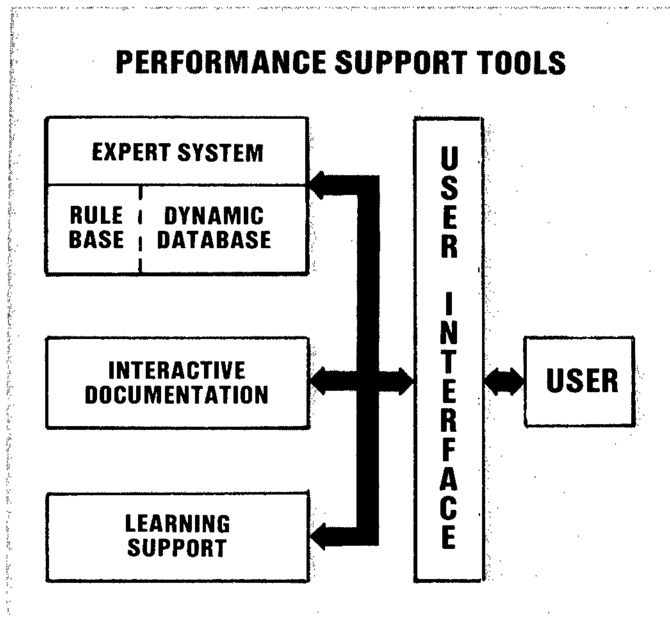

Figure 2.

Interactive Documentation

Interactive documentation is the knowledge base needed by the workers. For example, the knowledge base could consist of the contracting regulations or graphical displays of the electrical systems for a fighter aircraft. These interactive documentation systems are not limited to only text. They can contain text, graphics, full motion video, and audio data. The knowledge is structured in a hypermedia format. Hypermedia is different from fixed media systems such as printed material which is presented in a linear sequence. In a hypermedia format, information can be examined in a nonlinear method allowing the user to browse through the information in any order or depth desired by the user. For example, a maintenance technician using an interactive documentation component might ask to see the landing gear assembly. From this video display, the technician may ask to see wheel assembly technical drawings and the technical data on wheel fasteners. The next maintenance technician may access this same information, but in a very different sequence. Hypermedia allows the user of the system to pursue the available knowledge in the sequence which is useful to this user. In this way, performance support tools provide individualized mentoring to the worker who is using the system.

Expert System

An expert system is an attempt to share expertise among individuals. It is defined as "a computer program which incorporates the knowledge of an expert or group of experts on a particular subject and manipulates the inputted data in a fashion that mimics the human reasoning process." (3:29) In layman terms, expert systems act as intelligent assistants and advisors to humans about specific work domain problems.

Often human experts in many fields are in great demand. For this reason, the demand for human expertise frequently outstrips the supply. One solution to this predicament is to provide the expertise needed in some electronic form or, as Van Horn (12:1) described it, an "expert on a disk." The expert system distills the knowledge of many human experts. This knowledge is then coded as a series of production rules which is stored in a computerized knowledge base for later use. The expert system applies these production rules to a dynamic user-generated data base and to the interactive documentation database. By matching information in the databases with patterns in the rule base, the computer system simulates what a human expert would do if confronted with the same problem.

The value of expert systems rests in their ability to share with nonexperts the knowledge structures and rules that a human expert has developed and used when faced with a specific problem. In addition, an expert system can identify the limitations of its knowledge and explain its line of reasoning upon request. This feature of being able to explain its line of reasoning is what distinguishes an expert system from other computerized systems such as decision support systems.

An expert system may also prove to be valuable in training a new human expert. As individuals use the system for advice and reasoning through the explanation function, individuals will start to develop cognitive patterns (schemas) of their own which will not reside in the system but within the individuals. Over a period of time human users may become an expert in their own right.

For example, a supply technician may use an expert system to aid in the research process of cross referencing a part number to its corresponding national stock number. Not only can the expert system provide correct advice, but the system can also steer the user away from possible pitfalls such as mistaking the letter "O" for a zero or mistaking the number one for the letter "l" in the case of part number research.

Learning Support

This component is different than traditional computer-based training systems. The learning support component of performance support tools provides simulations, practices, and other activities designed for the individual to experience critical learning just before having to perform the task. (10) While it is different, learning support can use standard computer-base authoring systems for development. They can also use interactive video which is an excellent application of behavior modeling and social learning techniques. (1) For example, a loadmaster could observe the correct procedure for loading a specific type of hazardous cargo on a C-5 just before performing the task. After viewing the procedure, the loadmaster could review the procedure again, stopping the video at the critical point in the operation. Finally, the learning support process could provide the loadmaster with simulated hazardous cargo to load.

One final characteristic of a performance support tool is the way the user interacts with the three components of the software. The user interface is designed so the user can move freely from one component to another at will. For example, if the loadmaster was uncertain about a procedure during the hazardous cargo simulation, he/she could access the interactive documentation to look up a reference or access the expert system to receive advice and then return to the simulation to complete it. The end result is that a performance support tool provides powerful assistance to a worker at the work location.

Some Logistics Applications

Performance support tools are not just a concept. The technology is available today to design and develop this form of human performance aid. Not only are the resources available, these tools are being designed and built today. For example, AT&T has developed the Training Test Consultant. Test developers at AT&T use it to assist them in construction of valid tests.(10) Within the military, maintenance training programs are already starting to appear which move in this direction. For example, maintenance training for the new C-17 aircraft will be done using intelligent tutoring systems. These systems will allow trainees to simulate normal system operation, operational checkout, removal and replacement of components, and troubleshooting capacity. (2) The Navy is also using this concept for its new V-22 aircraft. The Army has developed a prototype intelligent tutoring system for the M-16 rifle. The system allows maintenance technicians total freedom to explore the effects of different repair efforts. (2)

Other logistics applications of performance support tools seem to be endless. For example, a hazardous cargo assistant which incorporates the regulations on hazardous materials, an expert advisor, and simulations for hazardous cargo movement would appear to be an excellent candidate. An electronic performance support tool for Quality Assurance Evaluators (QAE) would provide these individuals with the advice and the documentation they need to perform their jobs. Given the power of the new portable microcomputers, performance support tools for AQEs might be designed and delivered in a portable form. A performance support tool for supply customers would assist customers with the complexities of the supply system and would substantially reduce the need for supply customer training. Finally, mobility exercises and deployment could use an aid of this type both for freeplay in an exercise mode and as an actual advisor during real deployments.

The potential applications of performance support tools seem tremendous. But more important is the enormous quality improvements in human performance that will be realized. Empirical research has shown that a technician with minimum training and a performance aid will perform as well as or better than a technician with a higher level of training and experience but no performance aid. (6) Consequently, performance support tools enable people to perform better by providing them the knowledge to do the task and individualized methods of accessing that knowledge.

Conclusion

Louis Pasteur is credited with saying that "chance favors the prepared mind." (8) With the complexity of today's logistical environment, having a prepared mind means having access to a great deal of knowledge. Having access to this knowledge does not mean having to store and retrieve all that knowledge from a mental source. Performance support tools facilitate and support the human performance process. They empower logisticians by providing them with the knowledge they need to perform their logistic jobs effectively.

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[7]System members are any employees in an organization, work group, or team that share common processes and goals. System members are labor, staff and/or management. In the broadest sense, system members include the customer.

[8]Harrington, James H. "A Guideline to Improvement." This unpublished paper is distributed by OSD. Dr Harrington is President of Harrington, Hurd & Reiker.

[9]"Total Quality Management," Department of Defense, Washington, DC, Brochure, p. 2

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The Process of Excellence: A History of Quality in the Air Force Logistics Command

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By the end of World War II, the United States had become the most prolific industrial power on earth. Although many reasons competed to explain America's unrivaled productivity, one in particular had given the country an advantage over its beleaguered allies and broken adversaries. During the war, the US had attained its enviable reputation for production by fortuitously remaining beyond the reach of enemy bombers. It had escaped the aerial horror that crushes the wheels and gears of an industrial infrastructure. Geographic accident and the natural buffer zones of the Atlantic and Pacific Oceans had protected Americans from attack and the subsequent loss of production caused by bombed-out factories and incinerated refineries. Unlike Russia, Germany, or Japan, the US in 1945 had stepped unscathed from nearly four years of conflict with its industrial base not only intact, but remarkably improved. In fact, America's unfettered production of wartime goods boded well for its future industrial potential. Enabled by the war, the US had marshaled its physical bounty to evolve a production apparatus historically unique. Abundant natural resources, blossoming technologies, ample labor, and an around-the-clock work ethic had converged to assure Americans of their material prosperity in the foreseeable years ahead. Where the factories of other leading capitalist countries fell beneath the barrage of wartime offensives, those of the United States had flourished. In the end, US industrialists would encounter comparatively few barriers and meet little foreign competition in their postwar quest of the 1950s and 1960s to preserve, develop, and defend distant markets.

By the 1970s, however, global economic conditions had changed. So, too, had the manufacturing orientations of American industry toward building consumer goods. Productivity and quality assurance efforts in the workplace had withered dramatically, a decline resulting in a lower standard of living. From 1945 through the 1960s, US manufacturers had grown accustomed to an annual 3% rise in the rate of production. But in the 1970s, that figure had dropped to just over 1% to rank among the lowest of major industrialized countries. As a consequence, creeping inflation, increased unemployment, the diminished value of the US dollar, signs of an impending trade deficit, lower profits, and a weakened ability to compete internationally soon flooded the void left by the productivity gap. And worldwide competition for precious international markets had stiffened. Germany and Japan, hungry to reenter the marketplace after the war, had with unflinching discipline rebuilt their factories and assembly lines and had recovered sufficiently to become fierce competitors for US manufacturers, who until then had assumed dominance over such consumer durables as radios, televisions, synthetics, and automobiles.[1]

To be sure, many complex and little understood factors had reduced American productivity, and many economists disagreed over the primary causes. But a loose consensus did form among some financial experts. Insufficient capital investment, smaller research and development budgets, heightened federal regulation, an alienated work force, and the intensified power of labor unions had gradually eroded factory production. Further, they pointed to one other factor: an important aspect of the downturn was an ominous decline in the quality of products rolling off American assembly lines.[2]

The Changing Notion of Quality

Before rapidly expanding market demands had forced industrial managers of the early 1900s to refine business practices to better challenge domestic foes, most American corporations of the previous century, unfazed by the elaborate technologies and complex organizational structures yet to come, had functioned on a simpler level than their modern-day counterparts. Businessmen, who had in many cases personally designed, marketed, and even delivered their own products, measured quality by straightforward, pragmatic yardsticks. If, for example, one manufactured buggies, the wheels either spun freely and true, or they did not. Leather harness came either finely or poorly stitched. When applied, latter-day quality initiatives entered the product *during* manufacturing rather than as an *afterthought* at the end of a production line. Indeed, though, the detailed legal requirements, logistical snags, and technical pitfalls that badger manufacturers today were undoubtedly less formidable before the turn of the century because of their relative simplicity.[3]

But as industry matured, from sole proprietorships of family-managed cottage industries to the gigantic and often impersonal conglomerates, specialization split manufacturing functions into smaller components. The different number of tasks to be governed skyrocketed and soon led to the profusion of "control groups" responsible for certain phases in a production line. These groups sought order in an otherwise tangled labyrinth of increasingly fragmented manufacturing processes. Yet, ironically, this growing host of controls in some instances hampered rather than helped productivity. Between 1910 and 1980, the responsibility for quality in US industrial production shifted *from* those workers charged with building integrity into the product step-by-step, *to* control groups who monitored quality at the end of the line. Simply, "quality control" inspectors, not the individuals who actually made the goods, now evaluated product quality. Conclusive results over time have revealed that this shift fostered undesirable conditions that threatened the manufacture of high-quality merchandise. Adversary relationships arose between workers and inspectors, as well as between quality and production departments. Employees also became evermore casual about the quality of their labor, and some lost sight of the ultimate purpose of the product they had made. Accordingly, scrap, rework, and inefficiency became regular features on the assembly line.[4]

Mindful of this heritage, modern industrial planners have pondered over the proper place for quality and over who in the process should control it: the business owner, the board of directors, various managers, a quality department, or the individual workers throughout the process? By the late 1980s, many within industry felt that responsibility for quality rightly belonged to those who made the product (or performed a service, if a service-oriented corporation) rather than secondary departments. Ultimately, most contemporary analysts have concluded that, if America is to regain a favorable reputation in the world marketplace, responsibility for quality must reside with all persons in the manufacturing process. Such revelations within the private sector have also come to the public sector, particularly at the federal level. One example of the interest government managers have known toward improving "Quality Assurance Programs" within their organizations occurred at the Air Force Logistics Command (AFLC), with headquarters at Wright-Patterson AFB, near Dayton, Ohio.[5]

The Developing Idea of Quality in Air Force Logistics

Because timely maintenance procedures and a ready supply of dependable spare parts are essential to a strong air defense, the ability of American industry to turn out reliable products and deliver prompt services is today an inseparable component of modern Air Force logistics. The success of the AFLC mission, then, depends on the productivity and quality of its outside contractors and its more than 98,000 military and civilian employees. Also, the state-of-the-art aerospace science central to the manufacture, operation, and repair of complicated weapon systems has clearly taken a quantum leap beyond the machine tool technology commonly used a century ago to fabricate such devices and support systems as, say, Springfield rifles and horse-drawn caissons. That process, of course, has been gradual. Where the modern sorcery of fiber optics and laser guidance is now commonplace, a pilot's eyes and his machine gun sights were the standard for avionics 70 years ago. Indeed, as technology has become more sophisticated, so too has the need for better-devised quality assurance programs. To understand its role and significance in daily AFLC operations, a brief history of quality assurance in Air Force logistics is helpful.

The Early Days to World War II

On 23 December 1907, four years after the Wright Brothers had completed their first successful flight at Kitty Hawk, North Carolina, the U.S. Army Signal Corps (later renamed the Army Air Service)—responsible for pioneering developments in US military aviation—published specifications for a "heavier-than-air flying machine." Signal Corps officials, apparently undecided on the specifics of the aircraft's future uses, required simply of the manufacturer (the Wrights) that the machine fly successfully. As there had never before been a US warplane, the Corps lacked the guidepost of preestablished benchmarks for military aircraft structural standards. Thus the quality of the craft could only be determined during its maiden flight, a seemingly inauspicious moment in which to test for excellence. Although Signal Corps planners had vague expectations for quality control, an unthinkable omission today, their desires were nevertheless implied: the airplane, at its very least, had to fly.[6]

By October 1926, after the U.S. Army Air Corps (redesignated from the Army Air Service on 2 July 1926 for reasons of prestige during a period of expansion) had accumulated more flying experience and had amassed additional pilots, planes, and a first annual budget of $14 million, the growing formalities of quality control and inspection became progressively more demanding. Recognizing the future implications for logistics, the service had also activated the Materiel Division (a forerunner of AFLC) on 15 October that same year to administer the rapidly expanding functions of supply and repair. As a result, Air Corps policymakers ultimately relegated those tasks to the Division's section in charge of procurements. Thirteen years later, on 1 March 1939, the Air Corps, substantially larger now than in the days of the frail biwing, and with swelling logistical needs, inaugurated a special Inspection Section within its Materiel Command to monitor quality and reliability in materiel, contractors, and contractor plants. But with the September 1939 German invasion of Poland and the likelihood of future United States involvement, foresightful defense planners preparing for war fretted over the visibility of American air power. Consequently, procurement requirements exploded as did the need for the Materiel Command's Inspection Section. More parts and repairs for planes, now made of metal instead of wood and cloth, meant a stricter, more elaborate inspection curriculum. By 19 October 1949, sufficiently experienced and battle-hardened by World War II, and altered by several organizational changes calculated to improve management and efficiency, the Inspection Division evolved into the Quality Control Division and was overseen by the recently formed (March 1946) Air Materiel Command (AMC). Surveillance inspections (those end-of-the-line "control group" reviews discussed earlier) of missiles, engines, rocket propellants, packaging techniques, and statistical methods for the control of production quality became its primary responsibilities.[7]

The Cold War Era

In the early 1950s, as US-Soviet relations hardened in the tense atmosphere of the Cold War, and while the capabilities of aircraft and missile technology promised more "bang for the buck," quality control for Air Force logistics donned an increasingly greater role. On 1 December 1952, to create a comprehensively integrated Quality Assurance Program throughout AMC (redesignated AFLC in 1961), a staff-level Quality Control Office was established under the leadership of a Brigadier General. An important precedent, this reorganization also extended for the first time quality assurance responsibilities beyond procurements and into the areas of supply and maintenance. Over the next decade, a flurry of reorganizations grappled with questions over who should administer quality assurance for the Command and exactly how that task would be accomplished. Significantly, the quandary over responsibility for quality had by 1963 also come to involve private industry, particularly spare part contractors on whom AFLC now relied for much of its inventory. After a particularly frustrating period riddled with faulty parts had brought the Command and industry to loggerheads, each holding the other responsible for poor quality control measures, a compromise between the two eventually forced both parties to reevaluate their respective quality control programs and strive for improvements.[8]

Between 1963 and 1973, persistent AFLC efforts to attain an efficient Quality Assurance Program had spawned a bleary welter of administrative and organizational changes, all of them attempts to affix proper responsibility for the manufacture of quality parts and the timely conduct of repair services. Many of the changes stemmed from a successive chain of sincere commanders who wondered whether the Command administrative structure for quality assurance should be centralized or decentralized? The fluctuating shifts in administrative style would be for future AFLC Commanders a recurring feature in the ongoing debate for control over quality assurance.

A Renewed Effort to Centralize:

On 1 July 1974, Brigadier General Charles E. Buckingham, Chairman of the AFLC Quality Assurance Committee (empaneled earlier to define quality-related problems), urged the approval of a new organization within AFLC headquarters and at each of the air logistics centers (ALCs). Responsible for impartial, detailed studies to identify and improve weak quality assurance programs throughout the Command, the Office of the Assistant to the Commander for Quality Assurance (synonymously referred to as the Quality Assurance Office) opened on 20 August 1974. With Colonel Harry C. Long at the helm, staff members set out to develop sharper ways to *measure* quality effectiveness and its related costs. For the first time, AFLC would have a single advisory body to treat quality-oriented issues. At least for the present, responsibility for these concerns would no longer be scattered helter-skelter among the Command's Maintenance, Materiel Management, and Procurement functions. With a newly centralized structure administered beneath one roof, officials expected that AFLC could review the agendum of its assorted quality assurance components to eradicate duplications of effort.[9]

Quality Cost Program

Colonel Long and his staff immediately tackled the problem of organizing a Quality Cost Program to identify those expenses suffered by the Command due to defective materiel. General Jack J. Catton, AFLC Commander, 1972-1974, felt that the stratagem might also pinpoint trends in those defects, define their causes, and, further, present solutions. Quality assurance analysts divided the previously discerned quality-related expenses into three cost categories: prevention, appraisal, and failure (which itself consisted of internal and external expenses). *Prevention* outlays were those costs connected to the design, implementation, and maintenance of the quality program, such as money spent to train personnel for quality assurance measures. A typical example of *appraisal* costs included the money spent to audit contracts to confirm their proper administration and conformance with prescribed standards for project quality. *Failure* costs related to materiel defects that required rework labor and materiel, or that resulted in spoilage, scrappage, or transportation expenses. More specifically, *internal failure* expenses often stemmed from those processes or products that could not meet quality standards and resulted in manufacturing or operational losses. Costs from *external failure* arose from shipping substandard goods to AFLC customers.[10]

Using these classifications, the Quality Assurance Office launched a landmark study in December 1974 and January 1975 to determine exactly how much annually, in dollars and cents, the Command lost through inferior products. An early discovery revealed that to draw reliable correlations between available cost data from the several ALCs would be difficult because of their operational differences. But a second finding pointed out that Command-wide failure costs were too high and that not enough had been spent for prevention and appraisal. Lastly, the study concluded that product rework expenses had been improperly reported.[11]

At the end of the inquiry, although the researchers admitted to approximations, they had nevertheless found that annual quality costs for the Command would exceed $49 million for the calendar year (CY) 1975. The office went on to state that even though no accurate figures existed to reflect the actual savings to be gained by using the Quality Cost Program, estimates calculated that if the plan reduced AFLC costs by only 2% annually, more than $991,000 could be saved each year.[12]

Apart from isolating deficiencies to assess fiscal impact, the Quality Cost Program dangled other incentives. For instance, the plan prompted managers to monitor more closely quality assurance measures and their results. The program also helped management select, after a perusal of the cost data, the most prudent alternative for remediation. For example, high failure costs could bring managers to spend more for quality testing and inspection and eliminate the causes born by defective products. Planners could also rely on quality cost statistics when designing their budgets for quality assurance programs. However the Cost Program were to be used in the future, it nonetheless remained for the first time that AFLC had fashioned a scientific tool to assess the annual monetary losses caused by product flaws.[13]

The Japanese Way: New Definitions of Quality Assurance

By the late 1970s, aggressive industrial competition from abroad, particularly Japan (its manufacturing base long since repaired from the battering taken in World War II), had threatened to pitch some of America's top manufacturers into bankruptcy. Names such as Toyota, Sony, and Fuji had captured much of the high-tech market previously controlled by American heavyweights like General Motors, RCA, and Kodak. What had once been scorned the world over as a label synonymous with frivolous trinkets and glossy lacquer, "Made in Japan" had become the hallmark of quality at its stellar best. How this had happened and what US manufacturers could do to recover their fair market share were hotly debated questions on both the minds of American producers and consumers. Although many factors underpinned the intricacies of international economics and trade, one issue eventually rose to the top: America had to improve the quality of its products, which in many instances were inferior to those produced in Japan. And one of the many lessons US manufacturers learned upon close inspection of Japanese processes was that domestic factories needed to draft long-range plans and set production goals that incorporated quality assurance incentives. As the popular slogan at a top US automaker *now* celebrates, "Quality Goes in Before the Name Goes On," Americans had to abandon their pursuit of "quick and dirty" profits for longer-term reinvestment for modernization and research and development if they expected to survive the onslaught of overseas imports. Hence forward, products had to roll off the assembly line in near-perfect condition. No longer would industry-wide recalls be acceptable to correct the manufacturing defects rampant at many US factories. Never again would the American consumer tolerate exploding gas tanks or cars that failed to run—not when foreign manufacturers could produce quality merchandise free of dangerous or pesky defects.

Though the private sector accent on quality had excited media interest in the early 1980s, the notion had not been a new one for the Air Force. As discussed already, AFLC had faced the issue squarely for nearly a decade since its 1974 establishment of the Quality Assurance Office. But, much like the industry upon which many of its operations depended, AFLC and subordinate ALCs had from habit come to rely on end-of-the-line inspections for quality control rather than "applying" quality at each stage of the repair or servicing process. In a 1 December 1980 letter, the DCS/Maintenance at HQ AFLC, Major General Earl T. O'Loughlin (later to be AFLC Commander, 1984-1987) summed up a new direction for AFLC quality assurance:

> Producing more is not the single solution. We must strive to place continuous emphasis on the quality of products we produce and learn to view the process of building in quality as a means of improving productivity. . .i.e., do it right the first time.[14]

The Concept of Responsibility for Quality Broadens

AFLC soon unfurled several new programs aimed to improve combat readiness. Part of that initiative included that workers take personal responsibility for quality on the production lines to "build in" excellence along the way. But, much like the automaker faced with volcanic fuel tanks, the Air Force also wanted to prevent quality-related accidents, especially when their origins could be traced to logistics.

Materiel Defects Threaten Flight Safety

The early 1980s had indeed witnessed the ripening of newly sprouted AFLC quality assurance efforts, and overall, the Air Force enjoyed its lowest number of mishaps since 1921. But in 1983, quality assurance investigators discovered what at first seemed to be a relatively minor defect that would soon have service-wide implications: the CM313 "Peanut Bulb."

The small incandescent bulbs, used daily by the Air Force in handfuls to illuminate airplane instrument panels, electronic equipment, and testing devices, and manufactured abroad, by late 1982 had earned a reputation as being unreliable. Apparently, the poorly-made glass envelope protecting the filament prevented the bulb from seating fully into its electrical socket, an aggravating condition that produced intermittent lighting. Though a minor flaw, it nevertheless threatened many Air Force operations, some of them critical. For example, often mounted in "press-to-test" indicator assemblies used to check electrical circuits, the defective version of the bulb could not light up to indicate whether or not a test had been performed properly. Further, and more ominously, investigators warned users that the light bulb, in some applications, might glow as intended during a test sequence, but fail to light during an operational mode. One such case occurred in January 1983. A T-33A aircraft attached to the 325th Fighter Weapons Wing at Tyndall AFB, Florida, aborted take-off when the rear cockpit fuel quantity low level light flashed on but the light in the front cockpit, in contradiction, did not. Although the lamp worked well in certain test modes, it had failed to alert the pilot to a critically low fuel level.[15]

Learning that the flawed bulbs threatened weapon systems and imperiled Air Force lives, ALC technicians hurried to strip all suspected offenders from their shelves. A prime example of a widespread materiel deficiency, the seemingly minor lamps, costing about 25 cents apiece and common as table salt, had endangered Air Force combat readiness. The fickle bulbs could have accelerated aerial mishaps. If the simple technology sparking the glow of a basic light bulb, when improperly applied, had jeopardized aircraft and crews, little imagination is needed to visualize the proportion of hazards menacing flight safety in those instances where truly complicated mechanisms go awry.[16]

PACER IMPACT

By the mid-1980s, an age of "Do More with Less" had fallen over the federal government, especially in the defense department. Since 1981, the administration of President Ronald Reagan had routinely approved yearly increases in the national defense budget to strengthen an armed forces stunted by previous decisions of the earlier Carter administration. But by 1985, amid rising public fears of a ballooning federal deficit, a fiscal twilight had darkened the days of easy spending. Congress, passing the 1985 Balanced Budget and Emergency Deficit Control Act, better known as the Gramm-Rudman-Hollings Amendment, acknowledged that escalated defense outlays had aggravated the national debt and that only strict controls could stem the ebbing tide of taxpayer dollars. In effect, the amendment cut annual defense allowances significantly. In an era of declining resources, military planners would now have to stretch their assets to meet defense commitments essential to national security.

On 31 July 1985, President Reagan, astride the spirit of the times, unveiled a plan to improve productivity in the federal government by 20% over the next seven years. To meet this challenge, AFLC planners, for their part, turned to PACER IMPACT, a program created two years earlier to increase Command efficiency and economy in its production and maintenance evolutions. The program emphasized three issues: *People* needed to be motivated and properly trained; the manufacturing or servicing *process* had to be controlled and employ the latest technology; and the *product* should grow in quality and quantity. PACER IMPACT (an acronym meaning Industrial Maintenance Productivity through Accountability, Creativity, and Technology), slated for ten years' duration, had been designed to perfect maintenance techniques at the ALCs by using five different development groups that managed programs by developing fresh initiatives. The groups succeeded because their members had come from ALC "shop floors" and had first-hand experience and ideas where improvements might realistically be made. Technicians who routinely performed depot maintenance would now decide how that workload could be more efficiently accomplished.[17]

Decentralization of AFLC Quality Assurance Responsibilities

Caught in the government-wide maelstrom to restrict spending, an AFLC "Tiger Team" assembled in the summer of 1985 to consolidate Command manpower allotments and eliminate unnecessary duplications of personnel. One of their more controversial and historic targets was the AFLC Quality Assurance Office and its ALC subordinates. In the Tiger Team's final report, and of its 48 different recommendations, one urged the abolition of all ALC Quality Assurance Offices and fewer staffers working in the HQ AFLC Quality Assurance Office. Reminiscent of pre-1974 organization, when quality assurance functions were both decentralized and in early stages of development, the new plan pictured the Directorates of Materiel Management and Contracting and Manufacturing filling the void left by the now-defunct and decade-old Quality Assurance Offices. Although the report could not quantify the alleged redundancy of responsibilities or tabulate in columnar form any actual savings the potential reductions might yield, the Team nevertheless voted in June 1986 to eliminate the Quality Assurance Offices at all ALCs and at Headquarters AFLC.[18]

Defending themselves against the looming reduction of their responsibilities, quality assurance representatives countered that if their offices closed, an independent, unbiased voice in the process of quality assurance would be lost. In its absence, they went on, quality functions would henceforth be overseen by the very organizations they were to monitor, much like the fabled fox supervising hen house security. Further, they urged, an element of organizational freedom would slip away with the inability to audit operations that crossed directorate lines of authority.[19]

Ironically, the organizational framework of the Quality Assurance Office itself had provoked the assault on its autonomy. The Assistant to the Commander for Quality Assurance, a full colonel, sometimes lost ground when up against AFLC Deputy Chiefs of Staff, usually general officers. And one necessary ingredient in a flourishing quality assurance program entailed complete backing from those deputy chiefs of staff. Lacking such support, the centralized quality assurance effort could not long survive and would lose its area of responsibility to the more powerful entities disinclined to permit the outside intrusions of well-intended though interloping advisors. The other chink in the armor of AFLC's Quality Assurance Office, was that, despite its 1975 consolidation by General F. Michael Rogers (AFLC Commander, August 1975-February 1978), the office had seldom exercised *absolute* control over the Command's quality assurance programs. To a large degree, quality assurance at AFLC and the ALCs depended on the performance of workers from the DCSs of Materiel Management, Logistics Operations, or Maintenance. Not surprisingly, these organizations eventually assumed the functional control of their own quality measures, further estranging the Quality Assurance Office. Through a series of gradual reorganizations over the years, DCS/Maintenance had chipped away at the exclusivity enjoyed by the Quality Assurance Office in matters related to quality. By August 1980, the Directorate of Industrial Maintenance Process Control (MAQ) had been installed to raise the product quality at AFLC's various depots. And particularly, as mentioned previously, in July 1982, Quality Assurance Office authority dimmed when MAQ shed its former skin to become the Directorate of Maintenance Quality Assurance. Worse for Quality Assurance Offices, in November 1983, a new Logistics Operations Center and a renewal of the DCS for Materiel Management drained even more power from the Offices because each of the new organizations employed specialists to control matters of quality assurance within their operations. In sum, these organizational realities had in part diminished the vigor of the Quality Assurance Office.[20]

On 8 February 1986, after much discussion among AFLC's affected functions had weighed its merits, the quality assurance organization decentralized. Its various duties would be spread among AFLC DCSs and ALC Directorates. "Designed to eliminate duplicated effort, save personnel spaces, and emphasize the placement of quality responsibility at the worker-level throughout the command," the dispersion received general approval.[21]

New Directions and Transitions

While the winds of change may blow hot and cold, they are seldom predictable. Newly appointed AFLC Commander, General Alfred G. Hansen (now retired), in August 1987, taking a personal interest in quality assurance, astonished the Command shortly after his arrival by reemphasizing the virtues of *centralization.* Some members of the AFLC Quality Council (an advisory group established upon the decentralization of the Quality Assurance Office), however, expressed surprise at the General's persuasion. Much of the year's efforts related to quality had just been spent on decentralization![22]

After a tour of AFLC and ALC facilities had prompted General Hansen to acknowledge the adequacy of the present quality structure, he nevertheless reminded attendees at a 17 December 1987 AFLC Quality Council meeting that:

> The time has come for us to shift our emphasis away from evaluating the goods and services we provide at the end of the process...and toward the process itself by which goods and services are actually provided.

Although the concepts were not new to AFLC quality assurance technicians, and they had been part of the professional literature for years, the General's observations did contain a revitalized emphasis. The new AFLC quality effort would "represent a culture change wherein quality becomes everyone's responsibility." He underscored that the allegiance to quality began in his own office and that it would "cascade" down to every person in the command.[23]

The Third Wave - Dr. W. Edwards Deming

Part of General Hansen's devotion to quality enhancement may well have come from events begun largely outside Air Force perimeters. Packaged for popular consumption and occasionally pitched with the zeal of revival tent evangelism, the idea of quality as the bedrock of better business had been around since the turn of the century and efficiency expert Frederick Taylor's school of "scientific management" (later loosely labeled "time and motion" studies). But the more recent progenitors of the present-day quality movement appeared at the end of World War II. In fact, several individuals would eventually achieve notoriety as free-lance consultants (or "Gurus" in the contemporary parlance of the discipline) by celebrating the benefits of "working smarter" through modernized manufacturing processes. Names such as J. M. Juran and Philip B. Crosby often dotted the pages of trade journals during the mid-1980s with their ideas of how to improve American industry to better compete with the Japanese and the developing Pacific Rim economies of South Korea, Singapore, Thailand, and Taiwan. But one among many stands out as the movement's patriarch: Dr. W. Edwards Deming. No discussion of quality would be complete without reference to the man who, some believe, fathered the "third wave of the industrial revolution." Where the first wave brought the machine-dependent factory, created by Eli Whitney and his cotton gin, and the second wave ushered forth Henry Ford and his age of mass production, the third wave delivered the quality assurance revolution of W. Edwards Deming and his statistical production improvement controls.[24]

Deming, a trained scientist, badgered stubborn corporations to use bone-dry statistical analysis to examine their processes and products to verify they were buying from the right supplier, and to see whether their products were as good as they could be. But ironically, American industry had turned a deaf ear to Deming shortly after World War II. Seeing little need for "quality" per se, many US industrialists, "living the arrogance of affluence," coveted the huge and quick profits generated by markets yet untouched by foreign competition. But the Japanese of the early 1950s, lean and hungry, having few natural resources, clung to Deming's lectures like magnets. Deming boldly promised that if they followed his methods, they would in five short years not only be able to compete with the West, but even more, that Westerners would hurriedly throw up protective tariffs as shields against the unexpected fusillade of quality Japanese exports.[25]

Today widely considered the elder statesman of the quality movement, Deming and his kind attracted little attention in the United States until 1979, when downturns in heavy industry had pressed many of this country's once-booming midwestern and northeastern manufacturing centers into little more than bankrupt potholes notched along America's metaphorical "Rust Belt." Dr. Deming, then in his seventies, holding a doctorate in physics, and previously nominated in Japan for the Nobel Prize, recaptured the American public eye in June 1980 when he appeared in an NBC documentary comparing Japanese quality with American quality. Establishing Deming as the world's foremost authority on that subject, the film would receive more transcript requests than any other produced by the network. As a result, in just a short time, he had signed contracts with Ford Motor Company and General Motors Corporation, two grand masters of the industrial world, to become according to Ford Motor Company, "our consultant, our catalyst, our philosopher, and a burr under our saddle when we're not making enough progress." Once accepted by such preeminent luminaries, Deming's enthusiasm for quality soon gained widespread support throughout not only private industry, but the public sector as well.[26]

Deming blamed management for most of the problems in the American workplace. Citing his now-famous "14 Point" plan for industrial administration, he claimed that workers, if permitted to do a good job, would. But the system, as it was, prevented them from producing quality items. Production quotas, Deming insisted, induce fear, which in turn cause workers to hurry through a process with little regard for the quality of their work. Further, he lamented that American employees were not given the opportunity to suggest simple solutions to ongoing problems, that managers had closed ranks to keep them outside decision-making circles. Also, cooperation rather than competition should be emphasized in the workplace. "Employee of the Month" awards and similar honors only divided employees, according to Deming, and frustrated mutual cooperation in the labor force. Moreover, instead of darting from supplier to supplier when dissatisfied or when seeking the best price, he suggested that a company was miles ahead to light on one jobber and establish a long-term relationship founded on loyalty and trust. [27]

Aside from these recommendations, Deming argued that a manufacturer had to produce an item "right" the first time, every time. Quality control inspectors caught defects only *after* they had already entered the production stream, a condition both too late and too costly. It was cheaper to build a product properly than to recall the deficient ones. Quality had to become "a way of life" among all aspects of industrial and service organizations, and that meant *all* employees had to be involved through quality awareness and quality training programs.[28]

General Hansen: Command-wide Quality Assurance Measures and Accountability

Shortly after his arrival at AFLC, General Hansen, a proponent of the Deming school, took a hard look at the Command to judge the breadth and depth of quality assurance as it related to Air Force logistics. In just a short time, the General would move AFLC's quality program beyond the supply and maintenance function to all Command operations, another precedent in the history of the program. At a 13 January 1988 AFLC Council meeting, he eliminated the Quality Council Executive Office. In its place, the Commander created a new position: Assistant to the Commander for Quality Programs (QP), with Colonel John C. Reynolds as its administrator. Broadcasting his intentions across the Command, General Hansen sponsored a variety of reports and news releases on the subject of quality and the new directions AFLC efforts toward quality would take. By 5 February 1988, reflective of the Headquarters initiative, QP offices had been established at the ALCs.[29]

Noting that attempts to improve quality had become "nearly an obsession with many U.S. manufacturers," General Hansen explained his vision succinctly: "My intent is to bring AFLC in line with this quality revolution. It's time we substitute an 'ounce of prevention' for 'a pound of correction.'" Although industry experts had advised the General that his goals would probably require a minimum of seven years before any results would appear, he replied: "I'm here to tell you I plan to change the course of quality in AFLC within the next year."[30]

Key Concepts - Total Quality Management Program

In the early 1980s, embarrassed by the inefficiencies of a sprawling acquisition system that had somehow permitted such dubious purchases as $300 hammers and $600 toilet seats, the Department of Defense unleashed a master plan to improve the overall quality of work and procurements made on behalf of the nation's defense. Entitled Total Quality Management (TQM), the program emphasized innovative methods of education and training for the logistics work force. By 1987, TQM had become a primary interest of the Secretary of Defense, especially as it related to military purchases and the quality of defense workers.[31]

With foresight, AFLC leadership had already begun to institute several key concepts for quality, ones which formed the core of General Hansen's revolution. One turned on the idea of "cascading," where top management personally oversaw quality-related goals at each ALC. Once the goals had been defined, subordinate directors and executives, facilitating education and worker awareness programs, passed information and training down to employees at the lowest levels of the Command. Quality was now not something to be delegated, but instead an endeavor for which *each* person in the production chain took personal responsibility. The Commander further underscored the importance of moving from product orientation to that of process awareness. Even more, AFLC officials had to become more attentive to customer needs than ever before. Traditionally US manufacturers had followed the directions given them by design engineers who set limitations on what could and could not be done when building a product. Now, customer requests would be acknowledged and their priorities, if at all possible, would be honored.[32]

A Quality Program for the 1990s: QP4

For the General's Quality Program to succeed, he recognized that workers at every level in the Command would have to rely on their common sense and native intelligence when striving to improve AFLC products and services. That sentiment was embodied in a program entitled QP4 and would become the Command's new quality program. An AFLC news release explained:

The Q stands for quality—not an organization but a condition. The four P's represent people, processes, performance, and products. Quality and the four P's really are inseparable, and the force that binds them together is applied common sense. The applied common sense of all the workers to their jobs becomes a force for the continuous improvement of everything related to their jobs. Common sense is an inexpensive, renewable energy source available at every workplace.[33]

Process Action Teams (PATs)

As part of the QP4 initiative, common sense also dictated that workers themselves knew best how to improve the products and processes they faced everyday. Consequently, AFLC officials asked employees to examine their production methods by using Quality Circles and the fledgling Process Action Teams, vehicles which both conformed to Dr. Deming's principles that all processes could be enriched. Basically, production and maintenance workers were in better positions to see problems than those policymakers sitting in distant offices removed from the daily "hands-on" experiences.[34]

PATs would be formed to review a process, seeking ways to improve its overall performance. Trained in analysis techniques that included flow charts, statistical process control, and data collection methods, team members obtained facts on which to base changes in the process under examination. In essence, PATs gradually sought to inject quality into every step of a process, an act which eliminated the need for quality control measures at the end of the line. Unlike Quality Circles, however, which were oriented more toward the worker and their problems within the work site, PATs were management-directed and tracked a certain process. But both groups addressed quality and could see the need for change at their respective levels. In the end, PATs (of which there were over 700 Command-wide in 1989) and Quality Circles improved lines of communications between supervisors and workers, thereby enhancing the AFLC work atmosphere to encourage the production of first-rate products and services.[35]

A Quality Philosophy and Bill of Rights

Although AFLC could not practically adopt all the philosophies espoused by industry consultants such as Deming or Juran because of the innate and sometimes awkward differences between corporate and military organizations, several issues applicable to AFLC did emerge from the collective wisdom of those experts: (1) management commitment, (2) employee awareness, (3) continuous process improvement, and (4) customer satisfaction. Important to General Hansen's program, the development of a Command philosophy about quality faced certain limitations if it were to be flexible yet still effective. For example, it could be neither a binding regulation nor all-inclusive. The philosophy could not circumscribe other quality efforts or become a "How To. . ."guide. The challenge inherent to the quality philosophy design process was to somehow convince workers that "Quality was king" without preparing another set of rules. In other words, AFLC planners sought fresh ways to motivate employees throughout AFLC and the ALCs to embrace the Commander's enthusiasm for quality and to assimilate new work habits.[36]

By spring 1939, Colonel Darrell W. Grapes, Assistant to the Commander for Quality, distributed across the Command a Quality Bill of Rights intended to instill among employees a sense that they were an important part of the revolution swirling around their job sites. Supporting the creation of an atmosphere of trust throughout AFLC, the Bill of Rights urged each member to contribute to safety, quality, and productivity.[37]

Conclusions

General Hansen's newly framed Quality Program sought to revolutionize the ways in which Command workers viewed their jobs. Through special training, indoctrinations on the benefits of quality, management acceptance, direct involvement on the part of all employees, and a Quality Bill of Rights and Philosophy, the notion of "quality" has begun to acquire a new personal meaning for all AFLC members, inspiring them to take greater responsibility for the excellence of their work, not only in maintenance or procurement tasks, but in all functions of the Command, whether as a gardener, secretary, or budget director. First, however, the normal human barriers to change had to be undermined. Some sociologists have suggested that to modify the often rigid cultural values by which a society defines itself, such as bigotry, sexism, or the depth of its work ethic, may take as much as a generation of reeducation or longer before desired patterns of behavior appear. Similarly, given the postwar history of American industrial management and its periodic warfare with a militant labor force, skeptics might suggest that it is premature to expect a spectacular overnight reversal in productivity regardless of the efforts made in quality programs in either the private or public sector. Yet, many corporations are reporting surprising upturns in sales and downturns in defects. And much of that improvement has come from those businesses who have brought their workers into the decision-making process. Employee recognition, increased responsibility, shifting assignments, and better training and education have all motivated many employees in the private sector toward greater quality.[38]

Although the revised AFLC quality plan is barely two years old, it has nevertheless relied on similar incentives as those in private enterprise to motivate and redirect employees. PATs, Quality Circles, awareness seminars, and a Command-wide Training Development Plan have all been measures to entwine both management and workers in mutual goals to better serve AFLC customers by working smarter and by stretching shrinking resources. In its brief history, the Commander's Quality Program has attracted the attention of such defense contractors as Boeing and General Dynamics, not to mention AFLC's logistical counterparts within the Army and Navy, in their own searches for a model from which to fashion quality programs. In an 11 July 1989 introductory speech before a gathering of AFLC training development planners, General Hansen concluded with confidence and ease that AFLC had the "best Quality Program in DOD." With ongoing cooperation from devoted AFLC workers and with the strong support of the present AFLC Commander, General Charles C. McDonald, and succeeding commanders, the Quality Program will no doubt go on to improve the level of excellence in AFLC products and services, now and in the years ahead.[39]

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READER EXCHANGE

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Low Intensity Conflict and Logistics

The threat of warfare between the Warsaw Pact and NATO forces is being reduced by the democratization of the Eastern Bloc. As a result of *glasnost* policies, tensions between East and West are being reduced. It is time for the US military to focus its attention, capabilities, training, weapon systems development, and the logistics support base to fight in a low-intensity or third world conflict. While we must keep up our nuclear deferent to thwart possible Soviet threats, we must also prepare our forces for the threat of fighting a conventional war anywhere in the world, particularly in a third world country. Recently, we sent forces to Panama and there is continuing talk of using American forces to help interdict the flow of illegal drugs into the CONUS. This option was discarded, but our political leadership may still send American forces to a country where the enemy may be a rag-tag militia who knows the country and will fight a guerrilla war. How ready are we to fight such a conflict and, more importantly, can we logistically support such a conflict without creating massive American bases that are sitting ducks for enemy attacks? Consider these logistics issues:

- Can our new weapon systems be supported in the field in a bare base environment?
- Is the reliability of new weapon systems high enough that we will not have to take in C-141/C-130 loads of spares to keep these systems operating and massive amounts of test equipment to perform these repairs?
- Are our logistics personnel fully trained in Air-Base-Ground Defense and infantry tactics, so they can defend themselves and their weapon systems, if the enemy attacks?
- Are we testing new weapon systems in the worse possible operational environments (can we combat turn a new jet when under simulated air and ground attacks) in a desert or tropical climate?
- Is our equipment designed to operate anywhere in the world with a variety of power services, so we will not be tied to a main operating base?
- Is our equipment easy enough to deploy and operate that we take it anywhere in the world fast and operate it for an indefinite period?
- Can our equipment be transported easily within the combat theatre with minimum mission impact (bare base to bare base)?
- Are our logistics forces adequately trained for bare base operations in any climate?

These logistics factors should be considered, as we reorient our strategies, and tactical and logistical mind-set from solely a European war scenario to that of facing a potential adversary in the jungles or desert of some third world country. We must be prepared to fly and fight anywhere at any time, but we must have the logistics support to make this happen.

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Writing Logisticians

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Words and logistics have a lot more in common than one might think. For one thing, they both have the same origin. The Greek word for "word" is "logos." That same Greek root is where both "logistics," or "skilled in calculation," and "logic" come from.

My experience with logisticians has shown me that, by and large, the relationship between logistics and logical, accurate words is not much more than etymological. Logisticians have never been particularly fond of words, nor have those whose livelihood and safety depend on logistics. We all recall that it was Admiral King, during World War II, who said, "I don't know what this 'logistics' is that Eisenhower keeps talking about, but get me some!"

Perhaps most disconcerting to some of us who pride ourselves on being BOTH logisticians and lovers of words is logisticians' tendency to treat words, not like some sophisticated piece of machinery they must repair, but like large packing boxes they must load on a pallet! Words and logisticians have not traditionally been good workmates. I will not go so far as to say that logisticians do terminal violence to words, but I must admit they are often guilty of felonious assault. Bobby Knight could have been talking to loggies when he said: "All of us learn to write in the second grade. Most of us go on to greater things."

Words As "Tools"

Logisticians tend to regard words in much the way they regard their tools—if they get the job done, they have served their purpose. Logisticians, however, often make those tools serve more than the purpose for which they were designed. For instance, logisticians are not content to say a new idea "improved" their operation or "increased" its capacity—instead, they say their idea "enhanced" the operation. "Enhance," for Air Force logisticians, has served more purposes than the American GI's helmet! It is used for every subtlety of "increase" or "improve" imaginable!

I think the reason loggies love "enhance" so much is because it never seems to suggest that what one "enhanced" was inferior to begin with! If one "increases" or "improves," then there must have been room for improvement. If one "enlarges" or "expands," then it must not have been too spectacular to begin with. But "enhance" suggests "what I had was pretty good, but believe it or not, I made it better!"

Equally impressive is the word "interface." Most current dictionaries do not list a verb form of this word, but established procedure has never inhibited loggies before. Although it suggests a physical juxtaposition one may have seen in a Picasso painting, the word "interface" is employed anytime loggies want to infer they have done—or are doing—a proper job of coordination. In fact, that is all "interface" really says: Coordinate. . . , but do it with an official sound.

Another favorite tool of loggies is "impact." Like "interface," "impact" is not yet listed in dictionaries as a verb meaning "to affect," but it sure gets used as one. For example, "Current inventory procedures will impact future expense projections." Why "affect" is no longer sufficient, I cannot imagine; but the space-age, percussive implications of "impact" seem to be exactly the right suggestion for loggies. Couple "impact" with some other reliable, loggie favorites and we have a language that defies analysis:

> The F-15 was seriously impacted in the late 1970s by an engine that became unsupportable due to reliability problems resulting from specification deviations and misinterpretations.

"Impressive" Words

Like the elaborate machinery logisticians often use, impressive sounding words have a special appeal. For example, loggies do not check a system to see what might make it fail—they subject it to "environmental stress screening." Elements of logisticians' operations do not just fit with one another—they achieve "connectivity." Finally, loggies do not just try to get the most out of two or more things—they strive for "synergistic" compatibility.

Getting Everything Out of Words

When writing logisticians are not milking meanings out of traditional words like "enhance," "interface," and "impact," they are using other traditional words so much that those words have lost their effectiveness. For example, loggies do not ever have an "idea" any more or do something "new"; they undertake "initiatives." I cannot tell whether "initiative" picked up its current baggageload of meanings on its own, or became popular with "initiate," a ten-dollar way of expressing the nickel concept "start."

Equally overused and overburdened, "issue" is reaching an all-time usage peak. Loggies do not say that anything is contentious, is a problem, or is the point of a discussion—it is an "issue." And "methodology" covers a multitude of sins—people may criticize their motives, but if they have a "methodology," they must know what they are doing.

A perennial favorite is the simple word "focus." Loggies (and a lot of their specialties) have crammed more different connotations into that simple word than one would have thought possible. Loggies no longer simply work a problem—they "focus" on its complexities!

When logisticians finally talk about favorite verbs, they are talking about words! Loggies do not "begin" anything anymore, or "execute" or "start"—they "implement." "Implement," with its equally popular noun form, is now the ONLY WAY to "put something into effect." Also loggies do not "spread" or "circulate" or "disseminate" anything—they "promulgate." They no longer "give" anything to anyone anymore—they "provide" it. And, saving the most famous—or infamous—to last, they do not seem to be able to "rank" items in some kind of order—they must "prioritize" them.

Coined Words and Phrases

Finally, as if adding new meanings to old words and overusing old favorites were not enough, loggies "reverse engineer" and coin words and phrases to cover those concepts and actions for which they feel no expression exists. For example, for hundreds of years people have been able to describe their response to a force upon them as a "reaction." But somehow loggies now believe "proactive" better describes a positive force than "act." Another current favorite word used to describe a healthy system, policy, or program is "robust," a word I always thought was more appropriately associated with steaks, wines, and well-endowed, rosy-cheeked people!

"Private" Meanings

While many of these examples may not have originated with logisticians, loggies make up for it by generating their own language. Many of their words have meanings "regular" folks will not recognize. In "loggieze," "indenture" does not refer to artificial teeth or a form of imprisonment; it is a method of identifying the stages of complexity of a system. "Recoverables," "exchangeables," and "consumables" are not patients, color-coordinated outfits, or TV dinners. They are components or items that can be removed and repaired or used and discarded.

"Buzz" Words and Phrases

Loggies use too many buzzwords and phrases. While this space is insufficient to list them all, I will mention a few. If loggies want immediate recognition, they tell bosses their decision will "optimize" or "maximize" support (but if it will not, then they say it will "suboptimize"). Some favorite words that often do not mean much are "iterative," "definitized," "inclusion," and "arena." "On condition maintenance" is a cryptic way of saying they check parts periodically to keep them from failing instead of just taking them off an airplane and replacing them.

Some logistical language is just so awesome it does not fall into any category. Terms like "Parts Count Reliability Prediction" and "Military Standard Requisitioning and Issue Procedures (MILSTRIP)" need no explanation.

Threes and Fours

If loggies are fond of words in specific combinations, it has to be threes and fours: from system program manager (SPM) to interim contractor support (ICS); from statement of work (SOW) to provisioning performance schedule (PPS); from assured system availability to contractor logistics support (CLS). Groups of four are no less impressive: from Depot Purchased Equipment Maintenance (DPEM)—now remarkably replaced by the more "descriptive" Dep/Rep Mod (Depot Repair Modification)—to Mean Time Between Failure (MTBF); from Mean Logistics Delay Time (MLDT) to Not Mission Capable—Supply (NMCS).

Poetic Loggies

Despite their "box-kicking," "wrench-turning" image, loggies can, in fact, be very poetic. "Hangar queen" is an especially apt description of an aircraft that has been so stripped of workable components, it can no longer function. Loggies can also be metaphoric, as when they say they must "get a handle" on a problem, or they have to "get their arms around it."

"Simple" Loggies

And, after all these examples of pretentious, awkward language to characterize their business, loggies can, in fact, be the models of simplicity. For example, the starting point of a problem or the money figures upon which the rest are based is called, simply, the "baseline." An inventory technique, popular in private industry and picking up advocates in DOD, is called "just-in-time inventory."

Perhaps I have been too severe on logisticians. I should couch my short analysis with the qualifiers that (1) not all logisticians are guilty of such overuse and misuse of our language, and (2) some of these sins I have discussed were, in all likelihood, started by another group of people like comptrollers or computer specialists and probably apply to their semantic habits equally well. But what irony that such imprecision would characterize the language of logisticians—those who share their name origins with "words" and "logic." Then, again, maybe loggies are the ones who should smile, since they do seem to understand each other pretty well. To paraphrase Gloria Steinem, maybe it is true that "Logic is in the eye of the logistician."

Ideally, the quality training program in a company should include the entire managerial and supervisory hierarchy, starting at the top. Such a proposal was, until the 1980's, seldom welcomed by the upper managers. Their instinctive belief was that upper managers already know what needs to be done and that training is for others—the work force, the middle managers, the engineers. The present atmosphere of crisis in some countries is forcing a reexamination of this belief.

Juran's Quality Control Handbook

Exploring COTS Support Alternatives: Achieving Compliance With Acquisition Streamlining Objectives

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Background

Commercial Off-The-Shelf (COTS) computers and peripherals are frequently selected for integration into major and less-than-major Department of Defense acquisitions as a logical and less costly method of supplying technologically advanced automatic data processing equipment (ADPE) capability in mission critical computer resources (MCCR) environments.

When selected for an MCCR application, COTS resources include commercially developed, general-purpose computers, peripherals, software, software tools, and documentation that can be purchased or ordered "off-the-shelf" or from a General Services Administration (GSA) schedule. Federal Supply Group (FSG) 70 applies for any necessary stocklisting of these kinds of items. In accordance with OMB Circular A-76 and in compliance with Congressional direction, depot level support for FSG-70 requirements is by contract with commercial firms which may be the original equipment manufacturer (OEM), an OEM licensed agent, or a second source repair company identified through competitive solicitation.

Currently, there are five major categories of contract depot maintenance services required and used to support the aggregate of FSG-70 computer and peripheral repair requirements: in-plant repair, on-site repair, on-call services, interim contractor support (ICS), and contractor logistics support (CLS).

The Past

Traditional AFLC support processes (provisioning, stocklisting, configuration management and control, replenishment procurement, and maintenance) have not been responsive to the unique logistics requirements of COTS FSG-70 computers.

Historical complications to maintenance contracting on an annual or multiyear basis included the necessity of obtaining Delegation of Procurement Authority (DPA) from GSA and contractors' refusals to accept provisions of the Service Contract Act (SCA). These issues are for the most part resolved. Additional past or current complications in obtaining adequate support are:

(1) The rapid technological and commercial obsolescence of many major DOD computer applications.

(2) Contractor refusals to accept Air Force contracting terms and conditions regarding standard reporting, system effectiveness levels, and period of performance.

(3) Obtaining qualified second sources which have adequate quantities of cleared personnel to support classified missions or projects.

The Present

These factors, in combination with concerns for improving support to major commands, cost considerations, and recent DOD requirements to streamline the acquisition process, have resulted in the Air Force Logistics Command (AFLC) selecting total CLS as the preferred method of support for FSG-70 COTS computers and peripherals.

CLS is a preplanned, permanent support mechanism which can be used to provide all, or a part, of the logistics support to a system, subsystem, major modification, or equipment for the period of its entire life cycle. CLS can be total, partial, or tailored logistics support to comply with the mission requirements of a specified program. To realize the maximum cost and support benefits, a decision to use CLS must be made very early in a program's cycle. CLS is selected with the concurrence of the user, supporting organization, and the acquisition agent. The CLS support decision must be supported by a Decision Tree Analysis.

The cost savings to be realized by using CLS are primarily cost avoidance. Provisioning, technical data acquisition and management, item management, and depot activation are eliminated when total CLS is used. Additional CLS advantages include a reduced response time for correction of maintenance problems, a negotiated contractor provided system effectiveness level, and penalty and incentive performance clauses.

CLS has particular applicability to FSG-70 COTS but has also been successfully applied to the support of aircraft, ground communications equipment, ground space equipment, and training systems.

The Future

Recent significant political changes in Europe and Asia forecast the need for more austere budgeting and better application of scarce financial and manpower resources within the Department of Defense. We must continually reassess and challenge those traditional practices which supported our Nation's security during the "cold war" and "detente." During the current environment of Declining Defense Dollars (D^3), each logistician or acquisition manager has the responsibility to evaluate the applicability of CLS to the programs managed. It will never again be "business as usual."

Integrating Logistics Reality Into Command Post Exercises

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Introduction

During the 1989 North Atlantic Treaty Organization (NATO) WINTEX/CIMEX command post exercise (CPX) in Europe, a single B-52G response cell achieved a level of logistics realism perhaps never before achieved in the CPX environment. Aircraft availability was maintained at logistically supportable levels and realistic demands were made for aircraft parts. System failures, aircraft inspections, and turnaround times for each aircraft in the "paper war" were based upon real world requirements. Something that military exercise planners and participants requested for years had become a reality.

This article presents a new and innovative, yet simple approach, developed through a Headquarters Strategic Air Command (SAC) sponsored graduate thesis at the Air Force Institute of Technology (AFIT), to overcome the lack of logistics realism which has long plagued CPXs.

A CPX is a military exercise in which the existence and the movement of combat forces are *simulated* as opposed to field training exercises (FTXs) wherein actual combat forces are involved. CPXs demonstrate the use of procedures and communications systems, and stress coordination between various echelons based upon a given operational plan. Command post exercises involve the use of carefully scripted information to drive exercise play to meet stated objectives. Response cells, which are usually small groups of forward-deployed personnel, complete the communications loop to various headquarters. They simulate the existence, capabilities, and requirements of combat forces in their communications as though actual combat operations were being conducted.

When logistics factors are not realistically played in CPXs, it is easy for exercise participants to acquire ill-conceived notions about actual logistics capabilities and responsiveness. The result is that logistics can be grossly underestimated or overestimated, or simply taken for granted. The fact is that logistics is an overwhelming constraining influence which is ever present, long before the execution of forces. Although CPXs should never be used for sustainability assessments or development of actual planning factors, CPXs should reflect a primary tenet of successful military thought which is the coequal status of logistics with strategy and tactics.

Understanding the Problem

Command post exercises have historically suffered from a lack of logistics realism. Logistics considerations have all too often not been given as prominent a role as operational considerations. Further complicating matters is that logistics realism can be difficult to achieve when virtually all forces are simulated in a "paper war." The unfortunate aspect is that, when logistics realism is missing, so is operational realism. The sober truth is that operational plans are constrained by logistics capability.

In most simulation-laden CPXs, logisticians play out little more than a token pencil-pushing role—leaving today's logisticians, and perhaps operations personnel, ill-prepared for the monumental logistics challenges they would face in actual combat. Fortunately, some recent events are signaling a drive to address this problem.

Exercise realism is of such high concern that the Joint Chiefs of Staff have mandated that the Services develop improved techniques to eliminate unnecessary exercise artificialities and improve realism. Such high level of concern is warranted when faced with the stark fact that, each passing year, there are fewer people with actual combat experience in the military services. Consequently, the most rigorous preparation for combat and combat support that military personnel receive comes through their participation in military exercises. Thus, exercises should provide the highest possible level of realism and rigor.

There is ample room within the scope of the overall operational objectives in CPXs to play substantial levels of logistics. Integrating logistics reality into CPXs can improve exercise play and pay important dividends in terms of overall preparedness. Not only can logisticians gain important combat support experience, develop their skills, and better understand the challenges of wartime logistics, but operators can also share in the benefits. Readiness can be improved because personnel could better understand the essential interdependence and interrelationships between strategy, tactics, and logistics. "Logistics . . . is the art and science that makes both tactics and strategies attainable."[1]

Today, there are two schools of thought about CPXs. On one hand, some maintain CPXs should be *procedural-only* exercises wherein only certain tightly-controlled elements of realism should be allowed. The benefit of this approach is that exercise planners have far more control in determining exercise outcomes and latitude in what activities will be exercised. On the other hand, some maintain, as do the authors, that CPXs should incorporate as much realism as possible within the inherent limitations of the exercise and the particular exercise objectives. Both groups do agree however that logistics realism must be improved in CPXs. It is more a matter of the extent logistics realism should play.

Logistics command, control, and communications should be heavily stressed in CPXs to permit realistic training in a framework that has some semblance of the expected combat support environment. Only then can decision makers formulate effective strategies and tactics and realistically practice making the tough decisions which will be necessary in an actual conflict when there is extreme competition for scarce logistics resources.

To provide logistics realism during CPXs, detailed real-time data is needed to govern aircraft availability within logistically supportable and feasible levels as well as provide realistic part demands. Required data elements include inflight discrepancies, repair times, aircraft turnaround times, and repair parts by national stock number (NSN), noun, quantity, and work unit code (WUC).

Past Approaches

Past attempts to incorporate logistics realism have had only limited success and in some cases only added an undesirable additional layer of artificiality. These include simulations, mathematical models, and random number generators.

When attempting to improve CPX logistics realism, there are several drawbacks to using simulations and mathematical models. First, both have inherent programming complexities. It is extremely difficult to account for all the necessary variables. Also, they tend to be difficult to update, requiring specially trained personnel who not only understand the model concept but also the particular programming language used. Such personnel may not be available when updating becomes necessary.

Random number generator approaches generally fail to involve an adequate number of draws from a random number table to provide a completely uniform distribution of numbers over the course of an exercise. Random numbers are used to identify various items from lists of discrepancies and repair parts using some corresponding numerical relationship. The lists are often based upon a limited number of peacetime high failure items and lack the detail necessary for meaningful exercise logistics play.

These approaches usually fail to account for the aircraft's changing performance, reliability, and maintainability over time. Quite simply, aircraft and humans perform much differently in war than in peacetime. Any system which is based on peacetime aircraft and maintenance data is likely to have substantial bias. In the case of the B-52G bomber, the peacetime data includes information influenced by aircraft standing on peacetime alert, undergoing weapons load training, or involved in maintenance personnel training, extended ground times, low utilization rates, and various other factors which would not exist when flying sustained contingency operations. Also supporting this premise is that aircraft flying contingency missions have different flight profiles, sortie durations, structural loading due to heavy munitions and fuel loads, and system operating cycles, especially for electronic countermeasures equipment.

Components with high peacetime failure rates may fail infrequently or not at all under sustained combat flying conditions. Conversely, components with low peacetime failure rates may fail frequently or even continually under combat flying conditions. Furthermore, the level of maintenance expertise is higher in the combat-oriented environment. People become resourceful as they find ingenious ways to maintain aircraft under the demands of war.[2] These factors represent just a few of the many reasons peacetime data fails to reflect the combat environment properly.

Thus, there exists an important need for a method to capture the significant differences between peacetime and wartime aircraft performance, reliability, and maintenance characteristics. For the SAC B-52G bomber, the HQ SAC BULL RIDER exercise in August 1988 provided data that would help separate at least some of the differences between peacetime and wartime factors.

1988 HQ SAC BULL RIDER Exercise

In August 1988, HQ SAC conducted exercise BULL RIDER, a 30-day war readiness spares kit (WRSK) validation exercise which involved seven B-52G aircraft from the 2nd Bombardment Wing flying wartime sortie rates and missions that approximated wartime operations. Basically, the data collected during BULL RIDER is very close to reflecting the actual performance and combat support factors for the B-52G flying contingency missions.

Perhaps the most salient fact to come out of the exercise was: "Peacetime data on the B-52G aircraft was rejected as a valid predictor of wartime maintenance requirements and supply demands. . . ."[3] The same finding was made by Boeing in the early 1970s when they compared CONUS-based B-52s with those flying combat missions in Southeast Asia.[4] Consequently, data from BULL RIDER represents the best currently available data source from which to model a B-52G maintenance database to depict contingency operations.

The Historically Modeled Logistics Database

To respond to the need for a realistic and reliable logistics database to support the SAC B-52G bomber during command post exercises, an historically modeled database was developed using data from BULL RIDER. The logic is that simulations and mathematical models are most appropriate when adequate historical data is not available and events must be predicted. But, when sufficient historical data is available which approximates the conditions to be modeled, an historical database becomes the most appropriate model as depicted in Figure 1.

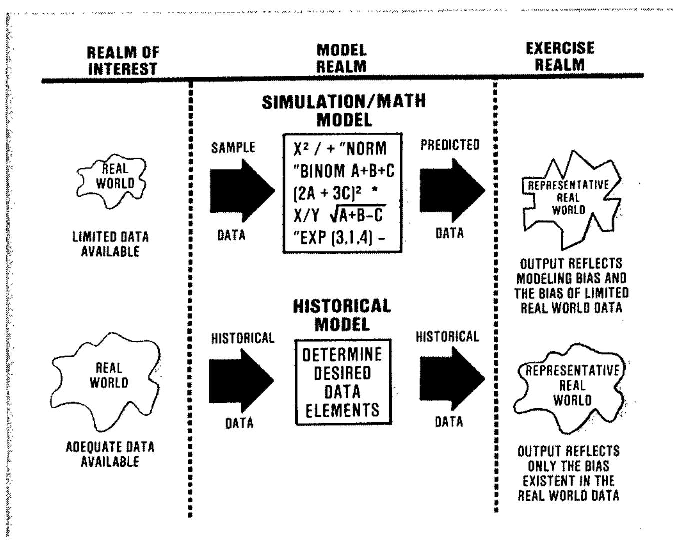

Figure 1: Comparison of modeling concepts.

Basically, an historical model uses actual data elements collected from a real world situation which closely correlates to the one we are attempting to model. For the B-52G bomber, BULL RIDER represented the situation which was desirable to model. An interesting feature of this approach is that any question of either internal or external validity is forestalled because actual aircraft discrepancies and parts requirements from BULL RIDER were used in a relatively unaltered state. This model directly uses data from aircraft which actually flew wartime-type missions as both input and output. Therefore, the changing characteristics of equipment and personnel over the course of the exercise are reflected in the output. This technique also ensures replicability of this methodology when applied to other weapon systems.

To develop the historical database, both maintenance and supply data from the BULL RIDER exercise were captured in the order the events occurred for each aircraft, sortie, and maintenance action. Maintenance and supply data were joined to provide a complete compilation of data for each sortie and inflight discrepancy. Data records were then separated by sortie and a "maintenance event control number" was assigned. A maintenance event includes all discrepancies associated with a single sortie. After a detailed data validation procedure, unnecessary data elements were eliminated. The completed database included the following fields: maintenance event control number; landing status code for each discrepancy; fix time for each discrepancy; the NSN, noun, WUC, and quantity for required repair parts; and the discrepancy.

Benefits From Using the Historical Modeled Database

Several benefits are derived from using historically modeled databases as shown in Table 1. First, the database reflects the real world, and many extremely complex and difficult-to-model real world influences are automatically accounted for within the model. Secondly, performance, reliability, and maintainability changes are reflected within the database. Third, exact information about NSNs, quantities, WUCs, repair times, and discrepancies is readily available. Fourth, the database is easy to develop initially and to update when systems are modified. Fifth, the database is based on real events; therefore, users find it easy to learn and have confidence in the output. Another benefit is that use of the historical database is not dependent on a computer.

HISTORICAL MODEL	*SIMULATION/MATH MODELS*
Reflects real world	Predicts real world
Reflects changes over time	Hard to reflect change
Detailed	Not highly detailed
Simple to develop	Difficult to develop
Easy to update	Hard to update
Easy to learn	Hard to learn
Not computer dependent	Computer dependent
Results are foreseeable	Results harder to foresee

Table 1: Comparison of Model Attributes.

An additional important benefit of historically modeled databases is that results can be foreseen. Proponents of procedural-only CPXs believe that too much logistics realism can be detrimental for two reasons. First, exercises may get out of control because of the unknowns that reality often holds. And, secondly, the lack of logistics resources resulting from realistic consumption may bring an exercise to a standstill. Fortunately, it is possible to deal with both concerns effectively.

Historically, modeled databases allow exercise planners to foresee events and therefore make allowances for realistic logistics events, if necessary, within the framework of the exercise scenario. Naturally, the outcome is a better designed CPX. Secondly, a fact of war is that it is logistics intensive. If the lack of a given resource threatens to bring the exercise to a standstill and prevent the accomplishment of operational objectives, several things should be done. The discovery of the shortfall should be properly documented for later analysis and correction. Then, the responsible decision makers should formulate a strategy to deal with the problem based upon realistic limitations. If the resource is critical and no workaround for the resource can be determined, sufficient resources to keep the exercise alive can be artificially injected.

The Information Guide

The next step involved the development of a set of procedures to guide the use of the database as well as account for many aircraft maintenance requirements. An important premise of the information guide development was that, insofar as possible, all procedures would be based on actual real-world requirements rather than to just facilitate exercise play. Exercise participants should not have to learn a separate set of rules for sake of exercises. Another objective was to make the information guide easy to understand so it could be used by someone with almost no aircraft maintenance knowledge. Standardized procedures were developed to account for aircraft inspections, refueling, and weapons loading. Specialized worksheets were designed to streamline the plotting of exercise sortie, maintenance, and turnaround activities.

The information guide includes exact procedures on:

The Database Format
Aircraft Phase and Hourly Postflight Inspections
Handling Aircraft Parts to Include WRSK Issues and Cannibalization Procedures
Initial Forms Set-up
Plotting Sorties and Maintenance Events
Late Takeoffs, Air Aborts, Aircraft Battle Damage Repair, and Attrition
Additional/Replacement/Transient Aircraft
Flow of Exercise Events
Playing Multiple Locations
End of Exercise Actions

A Complete Logistics Database Package

The end result of the research effort was a complete logistics database package which includes:

- The B-52G aircraft maintenance logistics database
- Information guide
- Practice database to support pre-exercise training sessions
- Database evaluation to get user input for updates
- Worksheets to plot exercise activity
- Training slides to support pre-exercise training sessions

The entire package is intended to be used by response cells operating from their forward locations. This is because response cells represent the logistics intensive and logistics consuming nature of deployed aircraft units. Therefore, the B-52G aircraft maintenance logistics database places a tool within the hands of response cell members to smoothly and simply incorporate logistics reality into the CPX from their level. This follows because in a time of war, higher headquarters would receive communications from deployed aircraft units which reflect the logistics constrained status of the unit as well as their logistics requirements.

Database Field Test in the 1989 WINTEX/CIMEX

The complete B-52G aircraft maintenance logistics database package was field tested during the 1989 WINTEX/CIMEX exercise. One B-52G response cell was selected to use the new database while other response cells used the old random number generator system.

Response cell personnel found the new system to be a great improvement. It proved to be easy to use, created a very realistic environment, and set the stage for rewarding discussions about the combat environment. In fact, during interviews at the forward operating location, one member stated, "We got the results we would expect to get if the aircraft were actually out there on the ramp and flying the missions."

Post-exercise analysis of results revealed significant differences between the two systems in many areas. It is important to remember that the database results are based upon actual historical events. Three differences in particular illustrate the superiority of the historically modeled database over the random number generator:

- Mean time to repair (MTTR) for database aircraft was more than five times as long as random number generator aircraft. The MTTR for the random number generator was too short to be of any predictive value.
- Total hours available for tasking (aircraft not in maintenance or flying) for database aircraft were less than half that for the random number generator aircraft. The random number generator system can lead exercise decision makers to believe B-52G aircraft can be tasked for far more sorties than can possibly be supported.
- Parts consumption was much higher for database aircraft which led to almost twice the number of MICAP (aircraft grounded for lack of parts) hours. The random number generator simply did not generate consumption of a reasonable number of parts measured by any current prediction method.

The field test for the historically modeled database, information guide, and associated materials was a tremendous success. It proved the validity of this approach for broader use in command post exercises to impart a reasonable level of logistics reality.

Conclusion

In a period of declining exercise budgets and environmental concerns, CPXs take on added importance because they offer a reduced cost alternative to FTXs to satisfy many critical objectives. It is perhaps time to look beyond the current role that logistics plays in CPXs. Realistically, CPXs may never become a logistician's RED FLAG. But, the basic concept of RED FLAG, which is to prevent costly or fatal early mistakes in combat by better preparing fighter pilots for air combat, is valid for logisticians also. There is ample room within CPXs to incorporate logistics factors such that all personnel are confronted with and challenged by wartime-type logistics events.

Improved readiness can be the outcome of such realistic CPX training where the operator and the logistician develop a better understanding about how to most effectively use scarce resources to achieve a successful outcome in combat. In working towards the goal of improved exercise realism, historically modeled logistics databases can go a long way in presenting decision makers with realistic, credible, and consistently reliable logistics inputs.

The time has come for exercises to be true representations of reality—to put away the magic, square-filling, and "can't lose" scenarios. History is full of colossal military failures attributable to lack of logistics forethought. Future operations cannot afford to fail in this manner; therefore, the opportunity to add realism to command post exercises should be of the utmost importance in the present logistical environment.

Notes

[1]Ogan, Capt Andrew J. "What About Logistics," *Air Force Journal of Logistics*, p. 21 (Summer 1983).

[2]Boeing Company. *B-52D Operation—Southeast Asia vs CONUS*, Report D162-10015-1, Seattle: Boeing Company, September 1970, pp. 4-10.

[3]Department of the Air Force. *Final Report to EXORD 8802-88 Exercise BULL RIDER*, Offutt AFB NE: Strategic Air Command, 15 January 1989, p. 18.

[4]Boeing Company, Report D162-10015-1.

Best Article Written by a Junior Officer

The Executive Board of the Society of Logistics Engineers (SOLE) Chapter, Montgomery, Alabama, has selected "Rivet Workforce and the F-16 Block 40: The Convergence of Training Issues in the 388 TFW's Conversion" (Summer 1989 issue), written by Captain Elaine A. Robinson, USAF, as the best *AFJL* article written by a junior officer for FY89.

Most Significant Article Award

The Editorial Advisory Board has selected "Military Logistics After Gorbachev: Tomorrow's Challenges" by Major H. Robert Keller, IV, USAF, as the most significant article in the Fall 1989 issue of the *Air Force Journal of Logistics*.

USAF Logistics Policy Insight

Revisions to Mil Specs 7742D and 8879C

The three services have reached agreement on revisions to Mil Specs 7742D and 8879C. These specs address the screw threads on Class 3 threaded products for general aerospace and similar high-tech applications (nuts, bolts, and other threaded items). The revised specs do not change any geometric thread characteristics, but they do identify two application categories: Safety Critical and Other. "Safety Critical" is any application in which the failure of the thread could cause death, severe injury, or weapon system loss. "Other" is all other applications. Now, the design or support engineer will determine if the Class 3 threaded product is Safety Critical for the thread, annotate the drawings, and list which thread characteristics are critical, thus indicating those characteristics must be verified by 100% inspection. The revised specs list minimum characteristics that should be inspected by default, unless otherwise specified on the drawing. Draft specs have been in use for approximately a year; the revised specs should be formally published by late spring. (Col Jim Harrington or Lt Col Nick Hablenko, AF/LE-RD, AUTOVON 227-2875)

Engineering & Services Improvement Planning

Directorate of Engineering & Services (E&S) and Engineering & Services Center personnel are developing a corporate plan for base improvements. Their goal is to make air bases more capable of performing their mission and to create a sense of pride for every Air Force member, paying particular attention to junior airmen and young officers. They will focus on quality, pushing authority, responsibility, and resources as deep into staffs and units as demonstrated competence allows. The plan will stress teambuilding which cultivates creativity, innovation, and camaraderie, while simultaneously staying in touch with technology along the way. Following this framework, our leaders will have an objective comprehension of the world today and a futurist's vision of tomorrow. E&S personnel have already developed short-term objectives designed to fix the major commands' most compelling problems and are developing long-term programs as they look at the trends and strategic issues facing the Air Force and this nation. Together, this eight-month planning effort will result in a corporate plan that will guide engineering & services decisions into the 90s and beyond. (Col Scott, AF/LEEX, AUTOVON 225-1003)

Operational Requirements Review: Engineering and Services (E&S) Impacts

MAJCOM E&S involvement in the requirements review process is essential to ensure better integration of new operational systems and the basing system. New operational needs are explained in Statements of Operational Need (SONs) and requirements are outlined in Systems Operational Requirements Documents (SORDs). These documents serve as the basis for, and outline support requirements for, such systems as new aircraft, weapons, avionics, and support systems. From an E&S perspective, systems should be reviewed with the operational medium (runways, airfield lighting, etc.), facilities, utilities, fire/crash/rescue, land, environment, manpower, organization, training, and Services in mind. Roughly half of the 150 to 200 SONs and SORDs that reach the Air Staff each year impact E&S in some way. MAJCOM review should identify E&S support requirements far enough in advance to allow proper programming and planning. Also, the commands should not hesitate to recognize the constraints imposed by the base support structure on system specifications. Logisticians should be sure they are getting a chance to review all new systems in their infancy by getting on distribution for these documents with their command XP shop. (Capt Rich Fryer, AF/LEEX, AUTOVON 225-7774)

Changes in Infrastructure

Deputy Secretary of Defense Donald Atwood's 4 October 1989 memorandum on Corporate Information Management, as well as a number of Defense Management Report Decisions, will generate major changes in our infrastructure. A team is presently conducting a number of studies on the possible consolidation of several supporting functional areas and their related information systems within the Department of Defense. They have already reviewed the logistics area of warehousing and, starting in March 1990, will review Inventory Management and Contract Payment. The teams conducting these studies consist of functional and technical specialists from each of the Services and the Defense Logistics Agency. (Charles Davis, AF/LE-I, AUTOVON 227-9165)

New PALACE LOG Program

Logistics officers will have increased opportunities to career broaden under a new PALACE LOG program. The program will target officers who have five years' commissioned service and a qualified Air Force specialty code (AFSC) in a logistics discipline, and who are assignment eligible. Candidates will be nominated by their MAJCOM Deputy Chief of Staff for Logistics. Officers may volunteer for this special program using the AF Form 90. This initiative is designed to produce highly qualified logistics officers with both the depth and breadth necessary to fill top logistics jobs, as well as offer both rewarding and challenging job opportunities. (Air Staff contact is Maj Don Migaleddi, AUTOVON 225-2175; AFMPC POC is Lt Col Vega, AUTOVON 487-3873)

AF Supply Management Budget Decisions

Three FY90/91 budget decisions will significantly impact Air Force Supply Management:

(1) Investment spares (Budget Code 1 items) will no longer be provided free to base-level units. Conversion will occur in several phases. Replenishment spares will be capitalized into the Stock Fund at the beginning of FY91. Next, the Stock Fund will start paying the cost for depot repair of spares as of the last quarter of FY91. Payment will be by reimbursement from the new depot-level reparable Stock Fund division to the Depot Maintenance Industrial Fund. Effective in FY92 or 93, as systems are updated, all Stock Fund spares issues will be charged to base-level operation and maintenance (O&M) funds. A "two-price" system will be used, with serviceable transactions

at the higher price and reparable transactions at the lower. Finally, initial spares will be capitalized into the Stock Fund in FY94.

(2) AFLC will no longer pay the direct costs of operating the Stock Fund (item management, warehousing and distribution, tech data procurement, sustaining engineering, etc.) As of FY91 the costs will be added to Stock Fund surcharges. For the FY91 transition only, a major part of these expenses will be funded by a direct appropriation to the Stock Fund.

(3) Inventory Augmentation, a Stock Fund appropriation to acquire stocks for new weapon systems and missions, was terminated as of FY90. In the future, new requirements will be supported through increased surcharges.

The net result of these changes is that a far greater proportion of Air Force logistics costs will be passed to operational units in the cost of supplies. A typical fighter wing, for example, can expect to see its O&M budget more than double. The conversion process will be a challenge, but should better relate costs to the mission and give commanders much more flexibility in applying resources to meet requirements. (Mr Steans, HQ AF/LEXW, AUTOVON 225-2897)

Guaranteed Traffic for CONUS Freight Movements

The Air Force is increasing use of Guaranteed Traffic (GT) for CONUS freight movements. An expansion of the program follows a successful test at Dover AFB, Delaware, and Barksdale AFB, Louisiana. The Military Traffic Management Command develops solicitations to carriers in the categories of less-than-truckload, truckload, and specialized equipment based on point-to-region movement requirements of the origin bases. The capable low bid carrier is awarded all outbound freight by category and region. The key to obtaining lower GT rates is cargo volume. One approach to increase volume is for bases in an area to join together forming an origin cluster. Cluster cargo would be aggregated by the carrier. Solicitations are underway for base clusters in the San Antonio, Texas, and northern California areas. GT promises significant savings in DOD transportation dollars. (Thomas W. Spade, AF/LETT, AUTOVON 227-4742)

Fiscal Constraints on WRM Vehicles

The Defense Management Review process (DMRD 938) eliminated funding for war reserve materiel (WRM) vehicles in FYs 91-92 due to fiscal constraints impacting nearly all programs. This decision will not affect the programmed funding for replacement vehicles. It does mean no vehicles will be purchased for two years for program decision packages pertaining to air base operability, chemical/biological defense, and medical war readiness. The moratorium will preclude planned purchase of 1020 vehicles comprised of 26 vehicle types costing $98 million. The decision also applies to FY92 POM initiatives that include WRM vehicles. (Lt Col Phil Jung, AF/LEXP, AUTOVON 225-7047)

USAF Space Logistics

Since AFSPACECOM was established in 1982, the Air Force has been striving to incorporate space systems operations into the overall force structure, equal in stature with aircraft, missiles, and other traditional weapon systems. This process is known as "normalization." The 1988 Air Force Space Policy formalized the normalization effort. While much work has been accomplished to identify roles and responsibilities between major commands, logistics support concepts, requirements, and policies still need further identification and definition. A space logistics roadmap is being developed, tying new logistics support concepts and policy requirements to the evolving operational scenario for the Air Force. (Jana Cira, AF/LEYYA, AUTOVON 227-0311)

Wartime Concept of Operations

The Air Force Supply community has recently approved a wartime concept of operations that emphasizes unit self-sufficiency and further develops the concepts of forward stockage and mutual support. At the heart of the concept is the combat follow-on spares support (CFOSS) computation that will compute the requirement to support a specific number of aircraft within a theater or region for the day 31-60 support period. This requirement will be offset with the residual primary operating stocks (follow-on spares kit (FOSK)) expected to be available at the home base of the combat unit which will deploy with the intermediate level maintenance unit type code (UTC). The delta between the total requirement and the FOSK will become the stockage objective for theater/region distribution centers. Because we theoretically computed a large requirement to support a surge period, there should be enough carcasses to support a sustaining period if they can be returned to a serviceable condition in a timely manner. Consequently, in-theater repair and the repair and return of assets retrograded to technical repair centers become an important aspect in minimizing the cost of extended supply support. Also, a proactive distribution system is being developed which will allow the theater commander to maximize aircraft availability based on his order of precedence. Eventually, this system will be capable of sourcing lateral repair to ensure a supply of serviceable, critical spares. (Lt Col John Gunselman, AF/LEYS, AUTOVON 225-3854)

AF Equipment Management System

The Air Force supply community has been making vast changes in the Air Force Equipment Management System to make it more responsive to user needs. With a few minor restrictions (weapon systems, WRM, vehicles, computers, etc.), the level of approval for base-funded equipment items is now the organizational commander, who has total discretion on what to buy. New guidance further allows local commanders to buy an equipment item without a long approval (Budget Code 9). Tables of Allowance (TA) "add" items need to be forwarded only if the base/MAJCOM feels the item has worldwide applicability. Also, MAJCOMs can allow the base to bypass the Command Equipment Management Office (CEMO) and forward TA adds directly to the TA manager. Further guidance and restrictions can be found in AFP 67-2, *Supply Management Reference Book*, Volume II, Chapter 22. (If you have any questions, contact your CEMO or SMSgt John Pugh, HQ AFESC/DEMG, AUTOVON 523-6400)

WRM Subsistence Program

Over the past year, the Air Force has conducted a bottoms-up review of operational rations to ensure the force can be sustained during wartime, with the right quantity and quality of rations. The primary focus of the review was on fine-tuning requirements. Current policy does not always allow planners flexibility to meet specific theater and base mission requirements. For example, the same type of meal will be served whether it be from an existing dining facility or a field kitchen. Consequently, theater planners had to develop new planning guidance to meet their unique base requirements. In January 1990, the War Mobilization Plan was revised to reflect more theater specific guidance. In the near future new procedures will be provided to the field to compute days of sustainability. Another initiative, and possible solution to the meals ready to eat (MRE) rotation problem, is a new ration called the Operational Food Packet being developed by Natick Laboratories. It has a shelf life of 10 years at ambient temperature (six years longer than the MRE) and will be marketed as a disposable ration. We can expect changes in the subsistence program and an improved capability to feed the forces during wartime. (Captain Barb Moock, HQ AFESC/DEOP, AUTOVON 523-6129)

Changes for Mobile Prime BEEF and Prime RIBS

A two-year study resulted in major organizational and conceptual changes for mobile Prime BEEF and Prime RIBS. Effective 1 July 89, teams were transformed from small, single-skilled teams to squadron-sized combat support packages that deliver a full Engineering and Services capability. We further improved our warfighting posture by joining the engineer, firefighter, and services packages into a combat support force module and closely linked this module to the operational commanders—*our prime customer.* Flying commanders now know who is going to support them in war. (Captain Juan Ibanez, AFESC/DEOP, AUTOVON 523-6131)

Construction Technical Letter

A new Construction Technical Letter (CTL), "Management of the MILCON Planning and Execution Process," should have reached the MAJCOMs and bases by now. The CTL describes revisions to the planning and execution process that have been developed with the goal of improving Military Construction (MILCON) execution. The revised process involves an improved planning effort, a revised submittal requirement to Congress based on a parametric cost estimate, and a professional approach in refining the project requirements and definition by the designer. The new process emphasizes planning and brings design closer to construction start. The new process is effective immediately for projects in FY92 and subsequent MILCON programs. For projects currently under design authorized by a previous design instruction, there is no requirement to modify the ongoing design process. The traditional 35% design documents and cost estimate will continue to be adequate documentation for congressional submittal. Under the new process, project definition package and the parametric cost estimate are sufficient documentation for congressional submittal and fulfills the 35% design milestone of the old system. The revised program requirements have been approved by congressional authorization and appropriation committees. (R. J. Furlong, AF/LEEDP, AUTOVON 227-9886)

Temporary or Relocatable Facilities

Temporary or relocatable facilities, in normal or interim situations, must be programmed, funded, acquired, and used properly and prudently. Without proper controls, these facilities can become eyesores and maintenance funding sink holes. Recent guidance provided to each MAJCOM and a forthcoming revision of AFR 86-l, *Programming Civil Engineer Resources - Appropriated Fund Resources,* provide further detailed guidelines for the use and funding of temporary and relocatable facilities. Deputy Assistant Secretary of the Air Force for Installations guidance provides specific details on funding of temporary facilities: when required to accommodate activities displaced by construction, repair or renovation projects, programmed with either appropriated or nonappropriated funds; when required to support both a nonappropriated fund construction project and an appropriated fund repair project; and when relocatable facilities are used to support alteration, addition, renovation, replacement, or repair projects programmed with either appropriated funds or nonappropriated funds. An accurate understanding of these policies and regulations is essential when planning and using temporary and relocatable facilities. (Bonnie Morehouse, AF/LEEPO, AUTOVON 227-8902)

O&M Funds for Facility Repair Work

The Deputy Assistant Secretary of the Air Force for Installations (SAF/RI) has published new, more restrictive guidance governing the use of operation and maintenance funds for facility repair work. This type of work is normally accomplished to restore a facility to be fully functional for its intended purpose and preserve the Air Force's investment. Due to the relatively routine nature of this minor construction work, congressional oversight of these projects has not been exercised as it is for minor construction. However, a number of isolated projects which received negative publicity have caused Congress to institute new oversight procedures. Beginning with FY91, all O&M funded facility repair projects exceeding $500,000 must be submitted for congressional review. (Mike Miller, AF/LEEPO, AUTOVON 227-8957)

MWR Construction Program

On 21 Aug 89, the Deputy Assistant Secretary for Installations issued major policy changes to the Morale, Welfare, and Recreation (MWR) construction program. Reduced MAJCOM repair approval authority requires SAF/RI approval for repair or renovation projects on an MWR facility (for which nonappropriated fund (NAF) is the fund source for construction) if cost exceeds $500,000. Separate contract accounting is required for combined O&M repair and NAF construction efforts to include separate work schedules and separate categories of work on contract drawings. Full disclosure is required for NAF construction projects. Project documents will identify any repair or construction project done in conjunction with or in the vicinity of an NAF construction project. (Ginny Herrington, AF/LEEPO, AUTOVON 227-8902/8957)

Air Force Human Resources Laboratory FY89-90 Logistics R&D Program

The Air Force Human Resources Laboratory, Logistics and Human Factors Division, Wright-Patterson Air Force Base, Ohio, is the principal organization which plans and executes the USAF exploratory and advanced development programs in the areas of Combat Logistics, Acquisition Logistics, and Team Training Systems. Most of the Laboratory's efforts to improve Air Force logistics are managed within these sub-thrusts areas. Some efforts are undertaken in response to technology needs identified by the Laboratory, but the majority of the work is in response to formally stated requirements from various commands and staff agencies within the Air Force. Many of our projects vary from basic research aimed at producing new fundamental knowledge to applied projects which are intended to demonstrate the technical feasibility and military effectiveness of a proposed concept or technique.

Following are some logistics R&D projects managed by the Logistics and Human Factors Division, which will be active during FY89 and FY90. (Contact: Colonel James C. Clark, AUTOVON 785-3713, (513) 255-6797)

RELIABILITY, AVAILABILITY, AND MAINTAINABILITY IN COMPUTER AIDED DESIGN

OBJECTIVE: To develop methods and techniques of integrating reliability, availability, and maintainability (RAM) into weapon system design through the use of computer aided design/engineering (CAD/CAE) workstations.

APPROACH: The RAMCAD Software Integration Project is a two prong effort. The first part, which is a joint effort with the Army Armament Research Development and Engineering Center, involves creating software shells to integrate various off-the-shelf RAM analysis software into a CAD/CAE workstation. The second part includes conducting long-term research into the use of artificial intelligence to aid in analyzing a design for various RAM attributes and suggesting techniques to improve the design. (Matthew C. Tracy and Capt Mike Hanuschik, LRL, AUTOVON 785-3871, (513) 225-3871)

IMPACT OF STRESS ON COMBAT MAINTENANCE ORGANIZATIONS

OBJECTIVE: To develop techniques to prepare aircraft maintenance personnel for future combat environments to reduce the potential negative impact of combat stress and to validate those programs.

APPROACH: After an extensive review of the literature was conducted, it was found that very little research has been accomplished in the area of combat stress and its impact on support personnel—specifically aircraft maintenance personnel. From that point, a two-phase approach was developed. In the first phase, potential techniques will be identified and developed which will provide realistic combat expectations; provide better individual coping skills; increase unit cohesion; identify basic symptoms of stress; and provide basic, simple treatments of stress reactions. The second phase will entail further refinement of, and validation of, the programs developed. (Cheryl L. Batchelor, LRC, AUTOVON 785-2606, (513) 255-2506)

INTEGRATED MAINTENANCE INFORMATION SYSTEM (IMIS)

OBJECTIVE: To develop a prototype integrated information system for the flight-line maintenance technician which will provide all the diagnostic, technical order, training, and work management data needed for job performance.

APPROACH: A series of design studies and prototype field tests will be conducted to establish the display formats, man-computer interface, and information requirements for IMIS. Structured analysis techniques will be used to define information requirements for the system. The results of the analysis will provide the basis for design of the system. A prototype IMIS will be developed and evaluated in an operational environment. The prototype will be field-tested to evaluate the design requirements for integrating and displaying maintenance information. Specifications will be developed for use in procuring IMIS for operational application. (Major Ralph Kanko, LRC, AUTOVON 785-2606, (513) 255-2606)

INTEGRATED MAINTENANCE INFORMATION SYSTEM (IMIS) DIAGNOSTIC DEMONSTRATION

OBJECTIVE: To evaluate the capability of maintenance technicians to perform complex on-equipment diagnostic tasks, and the associated remove-and-replace tasks, using an automated technical order system containing improved technical data.

APPROACH: A prototype portable computer has been developed that plugs into the maintenance bus on advanced aircraft. This portable aid will download the built-in test data that resides on the bus and then will incorporate that data into the diagnostic algorithm contained in memory. The technician will be given the next best test until the fault is found. Then remove-and-replace instructions will be provided at the appropriate level of detail for the technician. Two organizational level demonstrations are included in the program. The first demonstration was conducted at Homestead Air Force Base in May 1989 using the F-16A/B aircraft fire control radar as the testbed. A small sample set of faults was inserted on the aircraft. The prototype portable aid with improved technical data, including diagnostics, assisted the technicians in performing the fault detection/isolation and the necessary corrective actions. The second demonstration will be with the Navy's F/A-18 aircraft. Improved technical data and presentation systems will be incorporated into the portable aid, based on the learning experience of the F-16 demonstration. The sophistication of the built-in test capability on the F/A-18 will permit a field test that demonstrates the future potential of advanced, job-aided, interactive, on-equipment diagnostics. (Capt Mike Seus, LRC, AUTOVON 785-2606, (513) 255-2606)

(Continued in Spring issue)

CAREER AND PERSONNEL INFORMATION

Civilian Career Management

LCCEP—An Educational Opportunity

One of the major drawbacks to training is *time*. How do we train people to do a better job when they are unable to leave their jobs for an extended period of time? The Logistics Civilian Career Enhancement Program (LCCEP) has found a solution. They have embarked upon a program to provide graduate training in the Science and Technology of Industrial Distribution and Logistics at The University of Texas, Tyler, Texas. The program is a 24-month (4-semester) program, but the unique part is the students only attend classes on campus for 30 days during each semester. The remaining course study is conducted through correspondence with the university while the student is back on the job. The course study consists of topics such as Research Techniques in Occupational Education and Technology History, Philosophy of Occupational Education and Technology (semester I), Industrial Systems Management, Trends in Industrial Training (semester II), Seminar in Technology: Statistical Process Control, Topics in Technical Programs: Materiel Distribution (semester III), and Trends in Industry and Industrial Technology (semester IV).

The program is a joint military and civilian program designed to provide a quality education for outstanding Air Force managers with a minimal amount of time lost on the job. The curriculum is rigorous and requires a concentrated effort to achieve academic excellence. However, the rewards in personal achievement, higher educated Air Force personnel, and the development of people capable of leading the Air Force into the twenty-first century are worth it.

If you are a candidate for this program and are an LCCEP registrant, contact your local training office for more details or call Ms Victoria Thrower, AFCPMC/DPCMLR, Randolph AFB TX, AUTOVON 487-5352.

Logistics Professional Development

Logistics Exchange Officer Opportunities

Have you ever wondered what it would be like to be an officer in another country's Air Force or in another branch of the US military? If you are up to a challenge, then this article is for you. The Air Force participates in exchange officer programs with several allied countries and other US forces. Tour length is usually two years with an option for extension. This program gives officers from both the USAF and other participating countries an opportunity to better understand each other's logistics systems and weapon systems.

There are 30 logistics exchange positions in 12 countries, plus two exchange positions with the US Navy. We currently have officers working in Argentina, Australia, Canada, Chile, Columbia, Ecquador, England, France, Japan, Philippines, Thailand, and Venezuela. The Navy positions are in San Diego and Philadelphia. Most tours find Air Force officers working on a country's Air Staff, major headquarters, or in a wholesale depot activity. Both Navy positions involve duties as depot officers, responsible for supply and transportation functions. Officers assigned to non-English speaking countries must be proficient in the native language prior to arrival. Officers in the following logistics Air Force specialty codes (AFSCs) are eligible to compete for these assignments: Aircraft Maintenance and Munitions (40XX), Transportation (60XX), and Supply/Fuels (64XX).

Like other special duty assignments, the Air Force Exchange Officer Program is highly selective. Officers must have an excellent record of sustained superior performance in their career fields, be recommended for the assignment by their commander, and be accepted by the host country. Additionally, officers going into language billets must have the minimum language aptitude to learn a foreign language or pass a language proficiency test. Language aptitude is measured by taking the Defense Language Aptitude Battery (DLAB) test administered by local CBPOs.

Officers requesting consideration for exchange duty should read AFR 36-41, *United States Air Force Officer Exchanges with Air Forces of Other Nations*, and submit an AF Form 90 to their CBPO. Assignments will be considered based on the officer's experience, language aptitude, preferences, and the commander's recommendations. (If you would like more information concerning logistics exchange assignments, contact one of the following Palace Logistics officer assignments teams: (40XX) Maj Billig, HQ AFMPC/DPMRSL1, AUTOVON 487-3556; (60XX) Maj Caruso, HQ AFMPC/DPMRSL2, AUTOVON 487-4024; (64XX) Capt Clarkson, HQ AFMPC/DPMRSL2, AUTOVON 487-6417.)

(Capt Tom Meredith, HQ AFMPC/DPMRSL3, AUTOVON 487-6417)

Future Depends on Quality—And Us

There are two reasons why I strongly advocate Air Force Logistics Command's Quality Program, QP4:

- We need it; and
- It works.

The truth is, we are staking our future on QP4. Quality, including the Quality Bill of Rights and the AFLC Vision, is the key to solving some of the unknowns that face us in the decade to come.

QP4 is a work ethic, and it requires a change in the way we think and do business. You know some of what QP4 stands for—process-oriented approach to achieving continuous quality improvement, involvement at every level, and strong partnerships with customers and vendors.

As QP4 grows and matures in AFLC, you'll understand that it also includes:

- more responsibility and accountability at the process owner level,
- an enlightened leadership style that fosters empowering team members, and
- fewer layers of supervision, cutting unnecessary oversight.

The payoff will be well worth the growing pains of change. QP4 will make us more efficient and more productive. But more importantly, QP4 is the most significant initiative that can give AFLC the flexibility to respond in a future that will call for rapid change.

We must have a future AFLC that is team-oriented, streamlined, focused on continuous improvement, and committed to customer satisfaction—and that simply adds up to QP4.

For anything you, personally, can do to help us "arrive" at this vision of quality in AFLC, you have my sincere thanks and the satisfaction of knowing you have contributed directly to making something good even better.

Gen Charles C. McDonald
AFLC Commander